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SCIENTIFIC RESEARCH, THE HOPE OF THE SOUTH[1]

By Dr. GEORGE D. PALMER

UNIVERSITY OF ALABAMA

I wish, first, to discuss the importance of scientific research to the nation as a whole; second, to contrast the scientific research done in the North and the Far West with that done in the South; and third, to suggest ways of building up scientific research organizations in the South or in any other region.

We all know about the "Report on Economic Conditions of the South" prepared by the National Emergency Council for President Roosevelt, and his statement that "The South presents right now the Nation's number one economic problem." This report emphasizes our poor ranking in education, housing facilities, etc., but barely mentions our low ranking in the field of scientific research. This is all the more remarkable since we now know that the present status of the United States as the leading nation is due primarily to the *unbeatable combination of business and scientific research*, backed by our great resources.

Big business to-day is exploiting the fruits of our scientific research laboratories—our last remaining frontiers, our so-called "inner frontiers"—as during the past century it exploited our exterior—or geographical—frontiers. There is one big difference now—we shall never run out of "inner frontiers." Success in one field of scientific research immediately presents many new and worth-while fields.

It is this scientific research, chiefly in the fields of applied chemistry and physics, backed by excellent industrial organizations, which has enabled us gradually to forge ahead of all other countries. Our nation has at last become intensely interested in scientific research, chiefly because there is "money in it" and also security against war. Dr. C. M. A. Stine, of the du Pont Company, vice-president in charge of research, has said that scientific research is a "definite contribution toward the maintenance of peace." It is the most useful tool of the democracies. If, as Walter Lippmann writes, "The democracies have become softened by a false sense of security," all the more do we need scientific research organizations to keep ahead of the dictatorships.

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[1] Address of the retiring president of the Alabama Academy of Science, Birmingham, Alabama, March 29, 1940.

Our nation has now become the center of scientific research primarily through the large amount of work done during the past ten years by our industrial, educational and governmental scientific research organizations. Approximately $500,000,000 is invested each year in scientific research in the United States. Half of this, or $250,000,000, is invested by industrial concerns practically all in the North and Far West; the other half is invested by governmental and educational institutions, primarily in the North and Far West.

Three examples will indicate the extent to which industry invests in scientific research. Note that I use the word "invest" and not "spend." The research budget of the du Pont Company for the year 1939, was $7,000,000; that of the Dow Chemical Company, $1,400,000. The California Fruit Growers Exchange reports that their research for the past twenty-five years has "so far paid more than $8,000,000 in direct profits to growers and has led to two by-product plants." Twenty years ago there were about 100 companies investing money in scientific research. To-day, there are over 2,000 companies, practically all in the North and Far West, investing large sums of money in scientific research. Now double the amount of work done by these 2,000 companies, and you will have the total of all research done, including that done by about 200 universities, colleges and various research institutions, again, located primarily in the North and Far West—the richest sections of our country—thus making these rich sections richer.

There is never any doubt about the profits of organized scientific research, and these profits are progressively increasing in these modern times. In fact, the depression years have been the most outstanding years for industrial scientific research. This industrial scientific research is leading us into prosperity and will continue to lead us through prosperous times. We are in a "new era," a more realistic world, whether we like it or not, based more and more upon scientific research. This condition exists primarily because we now have in the United States more cooperation between the men of business and the men of science. James Truslow Adams, the historian, states in "Democracy at Work" that, as a nation, "We depend more and more on brains and less on brawn. We create our new horizons in the laboratory."

Because of the commercial importance of scientific research, many new concerns are establishing, and many older concerns are expanding their research laboratories. For example, the American Cyanamid and Chemical Corporation has just completed its magnificent new scientific research laboratory in Stamford, Connecticut. The American Telephone and Telegraph Company recently announced that it will build a new $3,000,000 research laboratory at Murray Hill to be completed in 1941. Many more laboratories have been completed and others announced for completion in the near future.

The importance of scientific research is well illustrated by recent developments in the airplane industry. According to a recent announcement, most of the research has been completed for building bombers capable of flying across the ocean and back on one fueling. More research will be done, and we will make this transatlantic round trip bomber, and so it goes. This probably means that transatlantic round trip bombers will eventually end the United States' isolation policy.

To realize the importance of scientific research, one only has to think of some of the things that we did not have ten years ago, such as transoceanic passenger air service, streamlined trains, new nylon synthetic silk for hosiery, glass-building blocks, glass textiles and insulation materials, new synthetic rubbers, television, new and very strong plywoods, synthetic vitamins and hormones, sulfanilamide and sulfapyridine drugs, etc. This in itself shows that business has invested heavily in its research laboratories during the past ten years of depression. Certainly, a great future awaits us in the United States. This is impressed upon one when he remembers that the bulk of scientific industrial research in the United States only began with World War number one.

We are remaking the world through our "inner frontiers"—our organized research laboratories. The whole of our future mechanical civilization depends upon them. At the present moment, a large number of new products of the research laboratories are almost ready to be put on the market. Some are being tried now on a small scale in certain sections of the country. All these and many more will be commonplace in a few years. Thus we may easily visualize the tremendous effect of scientific research upon our nation as a whole.

Now, I should like to emphasize the effect of scientific research on a given geographical section of the country. It is now well known that our "inner frontiers" are in the scientific research laboratories. We can no longer go West! We are now developing a new civilization based upon the products of the scientific research laboratories. As a result of this tremendous amount of research activity in the United States (about $500,000,000 expended annually) the following rule stands out in bold relief: *The prosperity of a region is roughly proportional to the number of patents taken out in that region.* Consequently, you can readily understand that it is highly important that the South take steps so that Southerners intensely interested in the South will take out patents and develop fields which will utilize the resources of the South rather than those of some other section. This will create new industries and additional jobs in the South.

I realize the tremendous importance of the social, economic and educational forces that have such powerful influences upon our lives, yet as I see it, at the present stage, *the South's number one problem is the utilization of its natural resources through scientific research.* Our scientific research is lagging when compared with our social, economic and educational progress. The question immediately arises, what steps should be taken to enable the South to utilize its own natural resources? The general answer is—simply build up scientific research organizations similar to those in the North and Far West. Everything in science, as in other fields, is becoming highly organized. A lone scientist or inventor is able to do little. At the present time, we, in the South, need organization and help, but we should help ourselves. *We should develop our own scientific research organizations for work on Southern resources.* This may be done in many ways.

In the past, it has taken a man with determination, fighting ability, salesmanship and imagination to build up single-handed an industrial research laboratory in the South. We have had few such men. The only ones, so far as I know, are Theodore Swann, who lives in Birmingham, the late Charles H. Herty, who pioneered our new newsprint paper mill and laboratory at Savannah, and William H. Mason, of Laurel, Mississippi, who started the Masonite Corporation. If it had not been for Theodore Swann, the Monsanto Chemical Company would not now be in Anniston, nor the Swann Chemical Company in Birmingham, nor several other plants in other places. Swann has been the pioneer and one of the greatest exponents of Southern industrial research. The South needs more Theodore Swanns! In this connection, mention should certainly be made of the large part that patents played in the success of Erskine Ramsey, who likewise lives in Birmingham. Despite our lack of large industrial scientific research organizations, some outstanding scientific research has been done in the South. I should like to mention especially the making of cast-iron pipe by centrifugal force as developed in the Birmingham district.

The other day in his column in the Birmingham *Age-Herald*, John Temple Graves II described the following statement: "A revival of the pioneer spirit, a venturesome and creative outlook on the problems of our day," as the "eternal song" of Vanderbilt's Chancellor O. C. Carmichael. This is his "remedy for the sickness that has come over democracies." We need a revival of the pioneer spirit in scientific research in the South to-day.

Of course we are gradually developing some small research laboratories in the South, but this increase has taken place primarily during the past ten years, and is not at all in proportion to the amount of industry in the South. In fact, the scientific research laboratories pioneered by Swann and Mason are still the largest industrial research organizations existing in the South. Some of our paper mills are true Southern concerns and as such are helping to build up Southern scientific research. Apparently where the new research idea is born is where the research organization is built up, which in turn produces other new products and establishes more new industries with their resultant new research laboratories—the usual snowball effect. Ideas count tremendously in industry and most of them are born in the scientific research laboratories.

Heretofore, research activity has been in the interest of the North and Far West with the profits from new industries, monopolies of patents, etc., likewise going there. Although this scientific research has already greatly affected the South (and other regions) it will affect the South to a much greater extent in the very near future, and much more adversely unless we have our own scientific research organizations working in the interest of the South. The concentration of research in the North and Far West amounts to a scientific research differential, which is much more important than our freight differential, important as that is, because the research differential is more fundamental. We often hear of the absentee ownership of industries of the South, but we never hear about the absentee research done for these same industries.

A further step in the development of our Southern resources is being made at the present time, but it is the Federal Government who is doing it for us. I refer to the new $1,000,000 regional research laboratory recently established at New Orleans to obtain new products and uses of cotton, peanuts and sweet potatoes. This will help just as a government sweet potato research laboratory at Laurel, Mississippi, has already helped. More scientific research supported by the Federal Government is badly needed in the South. Although we recently obtained one of the four Federal regional laboratories—which in itself is geographically fair—in general, I can say that here again we have a governmental research differential. The rule of rewarding the institutions that have already established large research organizations is applied even by the Federal Government. Since the Federal Government invested $60,000,000 last year in research, this is a considerable advantage. It is only fair to say, however, that such a project as TVA with its many research activities tends to eliminate this governmental research differential, for those living in that region.

This generally accepted custom of rewarding those institutions that have already established large research organizations destroys enthusiasm for research in the South. This in turn, has its effect upon industrial scientific research, and thus is another and very considerable factor in making the South poorer.

While there has been some decentralization of plants, there has been much more centralization of research and management. Research and management which usually go together, determine where the excess money of a region ultimately goes. This centralization of research and management in the North and Far West has drawn most of our competent Southern scientists away from the South. Many Southern scientists in charge of very important research work in the North and Far West would like to work in the South but are offered little inducement. Many scientists in Southern colleges and universities desire to work on Southern resources but have few facilities.

If you list the most important raw materials, such as coal, iron, petroleum, cellulose, salt, sulfur, phosphates, etc., and include power, you will find that the South has a near monopoly, or, as a minimum, has its share, in proportion to the rest of the United States. Since scientific research is necessary in the development of these vast resources, the South has done little toward the utilization of these raw materials. What has been done has been brought about almost entirely by outside capital.

According to Georgia's geologist Garland Peyton: "The Southeast is the only sector of the United States whose agricultural diversities, climate and mineral resources are sufficient to make it wholly self-supporting from the raw material standpoint." The Southeast is destined to become the greatest chemical manufacturing region in the nation because of these natural resources. The flow of chemical industries, paper mills, etc., to the South during the past ten years is excellent evidence that we are on our way. Dr. E. Emmet Reid, chemical consultant to many industries and Southern colleges and universities, informs me that for the past three years there has been more actual construction of chemical plants, or total expenditure for chemical plants, in the Southeast than in all the rest of the United States combined. However, research and management have seldom followed the flow of chemical plants into the South. The time required for the South to take the number one position in the chemical manufacturing field may be definitely speeded up by organizing our own research laboratories—not waiting for the other fellow. Then, too, by planning our own research, we can gradually build up our own industrialization. If we do not organize our own companies, and plan our own research, we still shall have absentee ownership and absentee research, and the South will continue to send most of its excess money up North.

I believe that, as Stewart J. Lloyd, dean of the school of chemistry, metallurgy and ceramics at the University of Alabama, has said, "A group of business men in the Birmingham district should get together and build up an industrial scientific research organization—not with the idea of subsidizing research, but to make money." This would help the Birmingham district and the South. The Mellon Institute at Pittsburgh has evolved many new industries for that and other regions. This type of organization is everyhere in the North and Far West. We need more Southern business men interested in science.

There is another type of scientific organization that the South needs. The February 1 issue of *Forbes* (business magazine) contained the announcement of the next logical step in New England's systematic method of increasing its scientific research. The larger companies of New England already have their research organizations. Now New England is starting to make scientific research organizations available to all their smaller industries.

Many leading industrial executives and scientists, under the leadership of Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, have organized New England's various research agencies into a unit, which gives technical assistance to small as well as large business establishments having research problems. This large-scale cooperative research project is the first of its kind in the United States.

Economic difficulties forced New England to originate cooperative science. This is the answer to those who may say that the South—or any other region—can not afford to do much research.

I do not wish you to think that I blame the Northern and Far Western interests for what they are doing. I am sure that we would do exactly the same thing under the same conditions. They are simply using good business methods. The South should form similar organizations. What New England is doing, other regions can do, thereby benefiting science and industry in the entire nation.

We need not fear that we shall over-expand in scientific research. Chaplin Tyler, of the du Pont Company, believes that at the present time it would be profitable for industry in the United States to do five times the amount of research it is now doing. Thus, should the South expand its research, it would be building up industry in the nation as a whole.

Southern industry and, in turn, Southern agriculture would be benefited enormously. Dr. C. M. A. Stine states the following:

> Chemical industry spends 2 per cent. to 4 per cent. (as high as 7 per cent. in some cases) of its gross sales revenue on research; agriculture, in contrast, spends only about one seventh of 1 per cent. of the value of its products on research. As much as $240,000,000 might be expended annually in the United States on agricultural research and the expenditure would not be at all fantastic nor out of line with need.

Money for scientific research is the greatest need of Southern colleges and universities at the present time. The legislatures of the Southern states should appropriate additional money to the universities and other state colleges for scientific research. This is undoubtedly the most important means of building up scientific research within the Southern states. In addition to state aid, many gifts for scientific research from business men and endowed foundations have helped Northern and Far Western educational institutions. Few such gifts have been made to Southern educational institutions. Of course, Federal aid for scientific research in Southern educational institutions would help solve the problem. We can not build up Southern industrial scientific research laboratories without the cooperation of Southern universities and colleges.

A large number of individual companies and many trade associations make research grants to educational institutions. Need I say that very few of these are given to Southern colleges and universities? We need to increase our industrial scientific research organizations, along with our university and college research organizations, so that our Southern-trained young men will remain in the South and build up the South. These will be the men who will have new ideas and create many new Southern industries. If we train Southern men in scientific research, a certain proportion of them will remain in the South. Hence, the universities and colleges should take the lead in building up scientific research in the South. We should strive to have at least one institution in each of the Southern states granting the Ph.D. and M.D. degrees.

We should also build up natural science education in the secondary schools. At present there is a strong trend away from natural science in these schools.

We should establish our own nationally great colleges and universities, our own grants-in-aid for research, our own journals for the publication of research, etc.

A direct way to encourage scientific research in the South would be for the Southern states to forego taxes on industrial, as well as on college and university research laboratories.

Now I should like to mention just a few ways in which I believe the Alabama Academy of Science can help in this program. The more interest in science on the part of the people of the state, the better off science will be in the state. We are certainly furthering this interest through our Junior and Senior Academies of Science. For the first time we have several important all-year-round committees to carry on the work of the Academy. We are progressing in our finances, our membership, and in our journal activities. We should further expand our journal so as to be able to publish valuable research pertaining to the state of Alabama that would not otherwise be published and thus kept for posterity. Many colleges, universities and other institutions, primarily in the North and Far West, are beginning to publish their own scientific manuscripts. This is a necessary trend in view of the large amount of scientific research now being done. We should work for the establishment of similar publications in the South. We should also increase our grants-in-aid for research. These are all valuable and sure ways of building up science in the state. We need state aid to adequately finance the academy. I believe our next step should be the formation of a Southeastern Scientific Society (S.S.S.), perhaps later to become the Southeastern Division of the A.A.A.S., similar to the Southwestern Division, and meeting with our various state academies. This should stimulate further interest in science in the Southeast.

Finally, I should like to say that I sincerely hope that by the end of the South's "ten year program of economic and cultural enrichment" sponsored by the Southern Governors' Conference and to be climaxed by a great world's fair of the South in 1950, we shall be able to report much progress in scientific research. Therein lies the hope of the South for the utilization of its own natural resources.

SCIENTIFIC EVENTS

FIELD PROGRAM OF THE CANADIAN BUREAU OF GEOLOGY AND TOPOGRAPHY

THIRTY-SEVEN geological and topographical survey and exploratory parties, comprising a force of about a hundred and seventy men, have been assigned to field work this year by the Mines and Geology Branch, Department of Mines and Resources, Ottawa. These parties, most of which will be leaving Ottawa in the immediate future, will map and investigate areas in every mineral-producing province in the Dominion and in Yukon and the Northwest Territories.

In view of the wartime requirements of the nation, particular attention is being given to investigations in connection with such minerals as have a direct bearing on the war effort. The work of the bureau is largely directed toward the extension of the gold-mining industry, which provides foreign credits, and toward an evaluation of resources in petroleum, an increased domestic supply of which is necessary to limit dependence on foreign sources. Investigations will be made also of deposits of many of the so-called war minerals, such as chromium, manganese, molybdenum and tungsten.

Twenty-six parties will be engaged in geological surveys and investigations, and eleven in topographical mapping. In addition, two topographical parties will be employed on supervisory work. Of the geological parties, three will be in British Columbia, five in Alberta, one in Saskatchewan, two in Manitoba, two in Ontario, four in Quebec, one in New Brunswick, one in New Brunswick and Nova Scotia, one in Nova Scotia, one in Yukon and three in the Northwest Territories. Two other parties will be employed on the general investigation of deposits of war minerals, one in British Columbia and Yukon and the other in the rest of Canada.

The topographical mapping program for 1940 will be devoted entirely to surveys in the foothills district of Alberta, which is now of such importance as a potential source of petroleum supplies. Ten topographical parties, one control party and two supervisory parties will operate in this district.

THE COOK OBSERVATORY

PLANS to proceed at once with continuation of the astronomical work begun by the late Gustavus Wynne Cook, the Philadelphia industrialist and amateur astronomer, who died on June 4, have been announced by the University of Pennsylvania. The work will be done with the astronomical equipment assembled and used by Dr. Cook in his private observatory at Wynnewood, Pa., which has been bequeathed to the university.

At the time of his death, Dr. Cook was engaged in making a photographic map of the Milky Way region. In preparation for this work he acquired in 1936 an astrographic telescope, said to be the largest in the world. A little more than half of the Milky Way section has already been photographed and its completion will be one of the immediate objectives of the observatory.

Dr. Charles P. Olivier, Flower professor of astronomy at the university and director of the Flower Observatory at Highland Park, who will direct the new program, has announced that Dr. P. H. Taylor, who has worked with him for the past four years, will work full time, and that in addition three part-time astronomers have been added to the staff. These include I. M. Levitt and L. I. Tabor, who were associated with Dr. Cook for several years, and Dr. Roy K. Marshall, a member of the staff of the Franklin Institute. Mr. Levitt, also a member of the staff of the institute and a former student of Dr. Olivier, will continue the work he has been doing with the spectroheliοscope at the Cook Observatory, cooperating in an international project for the study of solar eruptions. Mr. Tabor, who has been in charge of the work with the astrographic camera, will carry forward the work of mapping the Milky Way.

The work of the observatory will be continued for the present on the Cook estate in Wynnewood. This will permit certain lines of investigation to go forward without interruption. The program will be coordinated with that of the Flower Observatory and the equipment eventually will be placed with that of the Flower Observatory at some suitable location. The Cook unit will maintain its integrity and the name of Dr. Cook will be perpetuated. He is said to have spent approximately $200,000 on equipment for his observatory.

The bequest includes two buildings—a "sun house" and a "star house"—in addition to the equipment they contain. The largest telescope in the collection is a 28½-inch reflector, which will be used for the study of stellar spectra for the solution of special problems. There are also, in addition to the astrographic telescope and the spectroheliοscope, a 15-inch horizontal refracting telescope and a new Schmidt Camera of 14 inches aperture.

THE ILLINOIS-INDIANA SECTION OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

The Illinois-Indiana Section of the Society for the Promotion of Engineering Education held its annual meeting at the University of Notre Dame on April 21 with an attendance of nearly two hundred. After the Rev. J. Hugh O'Donnell, C.S.C., president of the university, welcomed the group, the Rev. John J. Cavanaugh, C.S.C., who is vice-president of the university, spoke on "Intellectual and Moral Education at Notre Dame," pointing out that Notre Dame is primarily concerned with the intellectual development of the student, but at the same time it integrates the religious and intellectual elements in higher education. Dean D. C. Jackson, Jr., of the College of Engineering, discussed "Engineering and Religion" and emphasized that "definite attention to integrating an intellectual study of religious principles and convictions into the engineering curricula is essential for the best progress of the progression of engineering in its broadening scope in approaching social problems in the future." Professor F. G. Seulberger, director of industrial relations at Northwestern University, gave an interesting description of the plans for the new Northwestern Technological Institute. The section had two outside speakers: W. S. James, chief engineer of the Studebaker Corporation, and T. A. Boyd, director of development for General Motors Corporation. Mr. James pointed out that in industry the demand is for engineers well grounded in the fundamentals (physics, chemistry and mathematics) which should be taught throughout the entire undergraduate course in terms of their application to all types of engineering. Drawing upon his broad industrial experience for illustrations, Mr. Boyd emphasized the importance, regardless of the type of engineering studied, of pursuing the research method in all subjects.

The following officers of the section were elected for 1940–41: *Chairman,* W. A. Knapp, assistant dean of engineering, Purdue University; *Secretary,* George A. Maney, Northwestern University; *Members of the Executive Committee,* J. G. Potter, Armour Institute of Technology; L. F. Stauder, University of Notre Dame; P. G. Andres, Lewis Institute; H. A. Moench, Rose Polytechnic Institute, and F. L. Ehasz, University of Illinois.

OFFICERS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Dr. R. W. Sorensen, professor of electrical engineering and head of the department of electrical engineering at the California Institute of Technology, was elected president of the American Institute of Electrical Engineers for the year beginning August 1, as announced at the annual meeting held in Swampscott, Mass., during the summer convention of the institute. The other officers elected were: *Vice-presidents,* Everett S. Lee, Schenectady, N. Y.; J. W. Barker, New York; K. L. Hansen, Milwaukee; J. L. Hamilton, St. Louis; A. LeRoy Taylor, Salt Lake City; *Directors,* T. F. Barton, New York; M. S. Coover, Ames; R. G. Warner, New Haven; *National Treasurer,* W. I. Slichter, New York (reelected).

These officers together with the following hold-over officers will constitute the Board of Directors for the next administrative year beginning on August 1: F. Malcolm Farmer (retiring president), New York; C. R. Beardsley, New York; V. Bush, Washington, D. C.; M. Eldredge, Memphis; R. E. Hellmund, East Pittsburgh; H. W. Hitchcock, Los Angeles; F. H. Lane, Chicago; L. R. Mapes, Chicago; F. R. Maxwell, Jr., University, Ala.; F. J. Meyer, Oklahoma City; H. S. Osborne, New York; John C. Parker, New York; D. C. Prince, Schenectady; C. T. Sinclair, Pittsburgh; J. M. Thomson, Toronto; A. L. Turner, Omaha.

The annual report of the Board of Directors, presented at the meeting, showed a total membership on April 30 of 17,218. In addition to two national conventions and three district meetings, 2,047 meetings were held during the year by the local organizations of the institute in the principal cities and educational institutions in the United States, Canada and Mexico.

H. H. Henline,
National Secretary

RECENT DEATHS

Dr. Ralph Modjeski, civil engineer of New York City, known especially for his work as designer and consultant in bridge construction, died on June 26 at the age of seventy-nine years.

Dr. Fermen L. Pickett, since 1930 dean of the Graduate School and for twenty-three years head of the department of botany at Washington State College, died on June 27 at the age of fifty-nine years.

James Henry Fleming, of Toronto, past president of the American Ornithological Union and owner of a private museum of birds, died on June 27. He was sixty-seven years old. Mr. Fleming had been honorary curator of ornithology of the National Museum of Canada for twenty-seven years and since 1927 of the Royal Ontario Museum of Zoology.

Dr. Alfred Fowler, the British astronomer, from 1923 to 1934 Yarrow research professor of the Royal Society, London, died on June 25 at the age of seventy-two years.

Dr. Augustus Edward Hough Love, professor of natural philosophy at the University of Oxford, died on June 5 at the age of seventy-seven years.

Robert Macfarlane Chapin, chief of the Biochemic Division of the Bureau of Animal Industry of the U. S. Department of Agriculture, died on May 6. He was sixty-two years of age. A correspondent writes: "A native of Massachusetts, Mr. Chapin was graduated from Amherst College in 1897. He took post-graduate work and served as instructor in chemistry until entering the service of the bureau in 1907. There he engaged in biochemical research relating largely to the development and standardization of disinfectants, livestock dips and related products. He was associated for many years with Dr. M. Dorset, discoverer of anti-hog-cholera serum, whom he succeeded as chief of the Biochemic Division in 1935. Since that time he has directed a wide range of research and service activities, including the preparation of tuberculin used in the nation-wide campaign to eradicate bovine tuberculosis, and also supervision of the stained antigen used extensively for the control of pullorum disease of poultry. Mr. Chapin was the author of numerous publications and collaborated with other investigators in many productive research studies."

SCIENTIFIC NOTES AND NEWS

THE Duddell Medal of the Physical Society, London, has been awarded to Professor Ernest O. Lawrence, of the University of California, for "his invention and subsequent development of the cyclotron."

THE Distinguished Service Medal was awarded at the New York meeting of the American Medical Association to Dr. Chevalier Jackson, until his resignation in 1930 professor of bronchoscopy and esophagoscopy at the Graduate School of Medicine of the University of Pennsylvania and at Jefferson Medical College, Philadelphia, and later, until his recent retirement, professor of clinical bronchoscopy at Temple University.

DR. A. C. FIELDNER, director of research at the U. S. Bureau of Mines, was presented with the Sullivant Medal of the Ohio State University at the commencement exercises on June 10. The medal is awarded every five years to "a graduate of the university for outstanding achievement."

DR. JOHN R. WILLIAMS has been awarded the Albert David Kaiser Medal of the Rochester Academy of Science "for service to the community and to the medical profession." The citation, according to the *Journal* of the American Medical Association, reads: "Dr. Williams has been the leading spirit, guide and director in the establishment of the Medical Museum in the Rochester Academy of Medicine, which from its beginning has maintained a high standard of educational value for the medical profession and the public."

IN recognition of his "outstanding service to psychiatry" Boston University conferred at commencement the honorary degree of doctor of science on Dr. Winfred Overholser, superintendent of St. Elizabeths Hospital, Washington.

DR. B. SMITH HOPKINS, professor of chemistry at the University of Illinois, was on June 10 awarded the honorary degree of doctor of laws by Carroll College, Waukesha, Wis.

THE Cross of the Commander of the Order of Alexander of Bulgaria has been conferred on Dr. Wolfgang Ostwald, professor of colloid chemistry at the University of Leipzig.

THE Robert Bunsen Memorial Medal has been awarded to Dr. Friedrich Rudolf Schenck, director of the State Institute for Metallurgical Chemistry at Marburg.

THE American Association for the Study of Allergy, meeting in New York City on June 10 and 11, elected the following officers: *President,* Dr. Robert L. Benson, Portland, Ore.; *President-elect,* Dr. Milton B. Cohen, Cleveland; *Vice-president,* Dr. Samuel M. Feinberg, Chicago.

AT the anniversary meeting of the Linnean Society of London held on May 24 the following officers were elected: *President,* Dr. E. S. Russell; *Treasurer,* Francis Druce; *Secretaries,* I. Henry Burkill for botany, and Dr. Malcolm Smith for zoology.

DR. EVERETT STANLEY WALLIS, associate professor of chemistry at Princeton University, has become A. Barton Hepburn professor of organic chemistry, succeeding Dr. Lauder W. Jones, who retired in 1937.

DR. FRANCIS CARTER WOOD has been made director emeritus of the Institute of Cancer Research at the College of Physicians and Surgeons of Columbia University. He will continue in private practice. It is also announced that the institute has been converted into the department of cancer research of the medical school, with Dr. William H. Woglom, associate professor of cancer research, as acting executive officer.

DR. ERNEST H. HUNTRESS, associate professor of organic chemistry in charge of the Undergraduate Division of the Massachusetts Institute of Technology, has become chairman of the Graduate School of Chemistry. He succeeds Dr. James F. Norris.

DR. J. P. GUILFORD, professor of psychology and director of the Bureau of Instructional Research at the University of Nebraska, has been appointed professor of psychology at the University of Southern California. Dr. H. M. Cox succeeds him as director of the Bureau of Instructional Research.

DR. JOHN L. RICH has been appointed head of the department of geology and geography of the University of Cincinnati; Daniel R. Bergsmark has been promoted from assistant professor to associate professor of geography, and Otto C. von Schlichten, to associate professor of geology. Dr. Kenneth E. Caster, curator of the museum, has been made assistant professor of geology.

DR. WYNFRID LAURENCE HENRY DUCKWORTH, reader in anatomy at the University of Cambridge, has been elected master of Jesus College.

THE du Pont Fellowship of the value of $2,000 for advanced study in chemistry at Harvard University, has been awarded to Douglas M. Bowen, of Glen Ridge, N. J.

THE B. G. Lamme Graduate Scholarship of the Westinghouse Electric Company for the year 1940–41 has been awarded to John W. McNall, research engineer of the company at Bloomfield, N. J. The Lamme scholarships are provided for by a fund, established about twelve years ago as a memorial to the late Benjamin Garver Lamme, who was for many years chief engineer of the company.

DR. EVARTS A. GRAHAM, professor of surgery in the School of Medicine of Washington University, St. Louis, president of the American College of Surgeons, has been made chairman of the surgical advisory committee on national defense of the National Research Council in collaboration with Surgeon-General James Carre Magee, of the Army, and Surgeon-General Ross T. McIntire, of the Navy.

LOREN C. EISELEY, assistant professor of anthropology at the University of Kansas, has a year's leave of absence to enable him to accept a post-doctoral research training fellowship in physical anthropology from the Social Science Research Council.

W. B. VAN ARSDEL has been appointed chief of the Division of Engineering and Development of the Western Regional Research Laboratory of the U. S. Department of Agriculture at Albany, Calif. He will be in charge of the engineering development of processes worked out in the Western Laboratory and the study of industrial opportunities for expanding outlets for farm products. Dr. G. E. Hilbert has been appointed head of the Starch and Dextrose Division of the Northern Regional Research Laboratory at Peoria, Ill.

DR. W. W. ALEXANDER has resigned as administrator of the Farm Security Administration to become vice-president of the Julius Rosenwald Fund.

ARCHIE J. WEITH has been appointed director of research at the Bloomfield Research and Development Laboratories of the Bakelite Company.

DR. NATHAN WEINER, of Harvard University, late research assistant to Dr. Arthur Michel, and Dr. Joseph T. Bashour, late research assistant to Dr. Zannetti, of Columbia University, have joined the research staff of Endo Products, Inc., Richmond Hill, New York.

DR. H. SHAW, keeper of the Department of Physics and Geophysics at the Science Museum, South Kensington, has been appointed acting director of the museum during the absence of Brigadier E. E. B. Mackintosh.

DR. E. H. CLUVER, secretary for public health and chief health officer for the Union of South Africa, has been appointed director of the South African Institute for Medical Research in succession to the late Sir Spencer Lister. Dr. George Buchanan, superintendent, has been appointed deputy director.

THE British Association has decided to cancel the Conference on Science in its National and International Aspects which was to have been held at Reading from July 25 to 27.

Nature states that the fifth International Congress of the History of Sciences will be held at Lausanne next September if the political and social conditions of Europe permit. M. Aldo Mielli, the perpetual secretary of the International Academy of the History of Sciences, having now settled at Santa Fé in the Argentine Republic as director of the history of sciences at Santa Fé University, M. J. A. Vollgraf, of Leyden, has been appointed assistant secretary for Europe. The review *Archeion,* the official organ of the academy, will henceforth be published at Santa Fé instead of at Rome as hitherto.

THE Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture took over on June 27 its new headquarters at 209 River Street, Hoboken, N. J., where imported plants must be treated before being admitted into the country. The building is four stories in height and was erected at a cost of $400,000. It took two years to construct and replaces a group of buildings in Washington in which the bureau was housed. The bureau will be directed by Dr. George G. Becker, senior entomologist.

THE U. S. Civil Service urges explosive chemists to apply at once for the civil service examinations now open for the various grades of chemist and chemical technologist positions in the federal service. It is pointed out that in connection with the present defense program it is important that a large number of well-qualified explosive chemists and chemical technologists be immediately available should vacancies occur in this field. The salaries for the positions for which these examinations have been announced range from $2,600 to $4,600 a year. Applications must be on file with the U. S. Civil Service Commission at Washington, D. C., not later than July 15, or three days later from states west of Colorado. Information in regard to the examination can be obtained from the Secretary of the Board of U. S. Civil Service Examiners, at any first or second-class post office, or from the Washington office of the commission.

AT the annual meeting of the American Society of Tropical Medicine in Memphis, the Bailey K. Ashford Award in Tropical Medicine was established by Eli Lilly and Company to provide for three awards on alternate years. The award will be $1,000 and a bronze medal suitably engraved. An additional amount of $150 or as much thereof as may be necessary is available toward traveling expenses for the recipient of the award.

Museum News reports that by the will of William Benbridge Wetherill, former president of the Tippecanoe County Historical Association, Lafayette, Ind., the Board of County Commissioners receives in trust for the association the Wetherill home, with its contents and a trust fund of $100,000 for the erection of a museum, or museum rooms and auditorium on the property. If the entire amount of the fund is not required for the construction, the remainder may be used for improvements or as a maintenance fund. The will provides also for a $5,000 trust fund to be added to Dr. Wetherill's previous gifts to the association.

A COUNCIL of eleven members has been named to conduct the newly established University Research Institute of the University of Texas, which will cover the field of research in business, city government, engineering, economic geology, industrial chemistry and the social sciences. It has been granted an initial budget of $25,000 annually. Members of the council include Drs. J. T. Patterson, R. L. Moore, E. H. Sellards, R. J. Williams, E. C. Barker, F. C. Ayer, J. C. Dolley and Theodore Hornberger. Dr. A. P. Brogan, dean of the Graduate School, has been made chairman. W. R. Woolrich, dean of engineering, and Dr. W. E. Gettys, director of social science research, have been named ex-officio councilmen. Dean Brogan explained that the new program will provide for the first time university money to match grants from educational and scientific foundations which have fallen heretofore outside established university studies.

A REPORT of the British Home Office relating to experiments on living animals shows, according to a summary in the London *Times*, that the total number of experiments performed during 1938 was 958,761, or 39,801 more than in 1937. The number of experiments performed with anesthetics was 49,915, being 9,596 more than in 1937. The number of experiments comprising inoculations, hypodermic injections and other proceedings performed without anesthetics was 908,846, 30,205 more than in 1937. Of the 49,915 experiments performed with anesthetics, comprising all the cases in which a serious operation was involved, 14,797 were performed under license alone or under certificate C, and therefore came under the provision of the act that the animal must be kept under an anesthetic during the whole of the experiment. The experiments performed without anesthetics—908,846 in number—were mostly inoculations and feeding experiments. In addition, a certain number consisted of oral administrations, inhalations, external applications and the abstraction of body fluids. A large number of experiments, almost wholly simple inoculations and similar proceedings, were performed either on behalf of official bodies, with a view to the preservation of the public health or directly for the diagnosis and treatment of disease. Over 183,000 experiments were reported by 365 licensees as having been performed for Government Departments, the Medical Research Council, county councils, municipal corporations or other public health authorities.

DISCUSSION

A POSSIBLE EXPLANATION OF DEEP-FOCUS QUAKES

IN view of the interest shown at the Washington meeting of the International Union of Geodesy and Geophysics in the explanation of deep-focus quakes, it seems appropriate to air a suggested explanation of such quakes advanced informally at a meeting of the Geological Society of America by the writer—an explanation which time has so far prevented his testing properly.

Seismological evidence indicates that some quakes have their origin as far down in the earth as 500 miles or more. From the large amplitude of the shear waves in these quakes we must conclude that considerable shear energy is released. This implies that at a depth of 500 miles in the earth we have a region where resistance to distortion is possible and shear energy can be stored up—quite contrary to geologists' notions of conditions at such a depth. In view of this implication, Jeffreys and others are prepared to attribute finite strength in the earth to this required depth of 500 miles. At the international meeting mentioned, Jeffreys seemed even willing to throw overboard the theory of isostasy. Before thus rejecting orthodox geological views of the earth's interior, the present note suggests another possibility, namely, that in the so-called deep-focus quakes, the quake or fracture actually occurs comparatively near the surface but that a real image of it is formed some hundreds of miles down and it is from this focal point that the seismologist's waves start. The first question that arises on such a hypothesis is—does the seismologist then receive waves both from the quake and from its image or only from its image?

Clearly waves must be emitted from such a near surface fracture, but there are two reasons why perhaps they are not recorded. It is not at all uncommon for the first impulse of a compressional wave on a seismograph record to be preceded some ten or twelve seconds by an emergence. As its name implies, an emergence is a gradual beginning. If we can actually identify such emergences ten or twelve seconds before an impulse, it may well be that some emergences too faint to be identified arrive many seconds earlier still;

hence, the first possibility is that at the quake itself the energy is spread over such a wide area that the waves emitted, unless brought to a focus, possess too little energy to make a perceptible record.

The other possibility is that the seismologists receive waves only from the real image of the hypocenter and not even feeble ones from the hypocenter itself. In this case we should have to postulate that the waves from the hypocenter were screened from the observing stations. The nature of this screening brings us to the question of how such a real image could be formed.

If we adopt Airy's view of mountain roots, it is easy to picture the roots as forming a vast parabolic basin which would act as a mirror with the reflecting surface the denser material in which the mountains may be considered as floating. If we take the Himalayas or the Hindu Kush Mountains where the quakes which occur are consistently of the same depth of focus, about 200 kms, the mountain roots would have to form a parabolic mirror extending this depth into the isostatic level and in length and width extending roughly the length and width of the mountain range.

Such a parabolic mirror, formed by sufficiently deep roots of a mountain range such as the Himalayas, could conceivably account for a real image of a surface fracture such as we have pictured, but the mountain roots would have to be deeper than previously imagined. For land quakes such as those occurring in the Hindu Kush Mountains, the fracture might occur above sea level, and hence only those rays brought to a focus below would be recorded. Those traveling direct from the fracture would strike the side of the mountain and give rise to but very feeble surface waves. For sea quakes, *i.e.*, quakes with their origin in sub-oceanic areas, we should have to postulate a screening effect by internal reflection from the sides of the parabolic mirror.

In conclusion, it must be emphasized that there is no evidence so far adduced to show that such image foci actually exist, but on the other hand there seems to be no evidence to show that they can not exist. Their existence is suggested as a possible alternative to overthrowing the existing geological picture of an earth with a rigid outer structure extending only some sixty or seventy miles. One step toward testing the theory is being made. Records of deep-focus quakes are being carefully scanned for evidence of phases earlier than the regular P phases. Naturally, one would not expect perfect screening of waves from an extended fracture and if there are two such hypocenters, a real one and its image, one should expect at least occasionally to pick up waves from each.

JOSEPH LYNCH, S.J.

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RESISTANCE TO SULFANILYL DERIVATIVES IN VITRO AND IN VIVO

DURING the past year and a half, we have characterized the growth of bacteria in broth by two constants, the time T required to reach a slight but definite turbidity,[1] and the slope K of the logarithmic increase thereafter. Organisms grown in the presence of sulfanilamide, sulfapyridine, or sulfamethylthiazole can show a marked increase in T accompanied by a much smaller change in K, indicating the development of resistance after a period of inhibition.

This resistance is partly temporary, and partly "permanent" (*i.e.*, appears in subcultures). The "permanent" resistance may be intensified by continued subculture in the presence of the drug, as shown by others for Pneumococcus[2] and Gonococcus.[3] We have found that eventually both T and K of the resistant strain grown in the presence of the drug approximate those of the parent strain tested in the absence of the drug.

The development of such resistance appears to be a general phenomenon. It also occurs *in vivo* during a course of therapy, as reported for Pneumococcus against sulfapyridine,[4] and as we have found in Staphylococcus aureus against sulfamethylthiazole.

The question arises whether organisms made resistant to one drug also are resistant to related drugs. We have found that two types exist, A, those in which resistance induced by one drug (*e.g.*, sulfanilamide) is carried over, and B those in which it is not. The metabolically versatile E. coli and Staphylococcus aureus belong to type A, whereas the fastidious Hemophilus parainfluenzae belongs to type B.

The implications of the foregoing for the theory of drug action and the control of therapy are obvious.

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COLLECTING SUBTROPICAL PLANTS AND ANIMALS IN NORTHERN OHIO

CONCERNING the spread of animals and plants throughout the United States, it is of interest to consider the probable roles played by the various aquatic plant nurseries, such as the William Tricker Company in Independence, Ohio, which import plants from many tropical and subtropical areas throughout the world, and, in turn, ship them to places all over the country.

During the entire year, the pools of this company serve as a reliable source of extremely interesting forms, which come and go. Those which are not quite so ephemeral remain and can be observed at any time.

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[1] The optical density determined in the Evelyn photoelectric colorimeter is directly proportional to the number of organisms.

[2] C. M. MacLeod and G. Daddi, *Proc. Soc. Exper. Biol. and Med.*, 41: 69, 1939.

[3] L. Westphal, R. L. Charles and C. M. Carpenter, *Jour. Bact.*, 39: 47, 1940.

[4] R. W. Ross, *Lancet*, 1: 1207, 1939.

For the last four years, collections of the red algae, *Compsopogon coeruleus,* have been made there. It is one of the rarer members of the family, and it is especially interesting to observe it spreading among local indoor pools and aquaria.

In January, 1934, approximately, *Lophopodella carterii,* the bryozoan, first appeared in the warm water of the greenhouse pools, and since has spread throughout northern Ohio. I have actually seen many plants covered with this beautiful form being sent to water-garden enthusiasts in various sections of the country. Interestingly enough, too, this same company has its main plant, seventeen acres of growing pools and greenhouses, located at Saddle River, New Jersey, the same state in which Dr. Dahlgren, of Princeton University, observed the animal.

Charles Otto Masters

Western Reserve University

COLLECTION OF UNORTHODOX CURIOSA

The writer has in his possession about two cubic feet of pamphlets and books, nearly all "published by the author," which fall in the category perhaps most charitably designated as unorthodox hypotheses in science (they bear earmarks which scientific men will recognize from this description), and which he has thought of donating to some institutional library where there might be a special interest in the history of science. The collection, for its possible value as curiosa, may not be considered worth shelf room, but, on the other hand, it might prove to be of interest or value to future historians of science and civilization, showing as it would that ours was not yet altogether an age of science, and that there existed among the public considerable opposition to what is often sarcastically described as "orthodox science."

Albert G. Ingalls

Scientific American

SCIENTIFIC BOOKS

THE PAGEANT OF ELECTRICITY

The Pageant of Electricity. By Alfred P. Morgan. xxvi + 363 pp. D. Appleton-Century Company. 1939.

This book is one in the series of "Science for the Layman." The author has written numerous books on popular science and has been an editor of a boys' magazine. However, this book is for mature readers.

The pageant of electricity is a brilliant and fascinating exhibition from whatever angle it is viewed. Here is pictured chiefly the application of electrical principles in commerce, industry, human affairs. The body of the text is preceded by eight pages of chronology of important dates (about 120) in the history of electricity from Roger Bacon to the present time. Three chapters, seventy pages, suffice to bring the story up to Faraday. In these chapters brief, very qualitative statements are made concerning electrical principles. Then the author turns to applications, the development of the telegraph, the career of Edison, the history of the telephone, "electrons dispel darkness" or the story of electrical illumination, electricity carries burdens, electricity and chemistry (the story of aluminum), electron bullets or x-rays, Hertzian waves and radio (100 pages), Doctor Electron or electricity in the hospital.

The story is well told. There is a wealth of historical material, quite a little of which is not found in histories of physics. The author is obviously well acquainted with the commercial side of electricity, and with museums in which are kept models of early forms of telegraph and telephone instruments, early incandescent lamps, electric generators, electron tubes, etc. Many interesting cuts illustrate these devices. Any one desirous of reading the story of the evolution of electrical applications will find these pages appealing and instructive.

The book can not be regarded as a history of electricity from the point of view of a physicist. For example, in the first few pages the author discusses the electron theory of matter. Here he is at least eight years behind the times. For, according to him, the nucleus still consists of electrons and protons instead of neutrons and protons. The term neutron appears once, but there is no place for it in an atom. A conventional model of a hydrogen atom is shown as consisting of two positive and two negative charges. There are other minor criticisms which may be made by a physicist.

But when the author turns to the development of commercial electrical devices, he is at home. Especially is this true in dealing with the contribution of Edison, of Bell, Marconi, DeForest and Major Armstrong. The patent litigation between the last two *inventors* requires several pages for its telling. Here the author very vigorously takes sides. He intimates that the Supreme Court was incapable of understanding the point upon which judgment was to be rendered. "Decision was rendered in favor of De Forest on a matter of *law,* the court not undertaking to *pass on the facts*" (italics are the author's). "But Armstrong had not lost any prestige in the scientific world. He remained the inventor of regeneration there." All through the discussion of the development of the electron tube and the associated circuits, the author makes it clear that he regards Major Armstrong as a brilliant experimentalist. For example (p. 303), "At twenty-three years of age Armstrong understood the audion better than anyone else in the world." The author does not seem to attach any importance to the pioneer work of O. W. Richardson in giving us the law of electron emission, of Professor Child in setting forth the space-charge relation, of van der Bijl, who gave the quantitative relation for amplification, of Wehnelt, Schottky and others, who had shown the importance of the emitting surface. None of these names occurs in the book.

The reviewer wonders if any one *invented* the regeneration circuit, or rather, if every one working with an electron tube, after van der Bijl and including him, did not invent it. Given the idea of amplification, the circuit is obvious. Many experimenters must have used the circuit, but they weren't in the patenting business. One wonders upon what towering pinnacle Major Armstrong would have been placed had the author been acquainted with or given attention to the recent loudly advertised frequency modulation.

In this chapter there is a minor criticism. The author accounts for the ending *tron* of many of our words, magnetron, radiotron, kenotron, etc., by saying that the Greek word *tron* means empty. There is no such word in the reviewer's lexicons. It is highly probable that the ending is due to that of *electron,* the Greek word for amber. It has a pleasant sound, so why not magnetron, etc.?

The last chapter deals with the attempts to cure human ills from the days when all was mystery and magic to the present time when there is a very small element of knowledge. There is held up for ridicule the use by the Rosicrucians of the occult powers of the magnet—or of something which they called a magnet—but praise is given to the use of fever produced by high-frequency radio waves in the cure of insanity and syphilis (!). It is stated that small-pox can be cured by red light and skin tuberculosis by blue. But the reviewer is of the impression that red light is used in small-pox cases as it is in developing a photographic plate. It would be better not to use any visible light. (Radiant energy is always present.)

In our enthusiasm for modern devices it might be well not to overstate our case.

Radio surgery or the use of the radio knife is praised. The radio knife, more accurately the radio needle or acusector, uses high-frequency oscillations for cutting out, by burning or searing, unwanted tissue. It is stated that Dr. George A. Wyeth, by inventing the endotherm, put electro surgery on the map. Now this instrument with the aristocratic name enables one to use *damped* electrical oscillations obtained by the old spark method or, by throwing a switch, *undamped* oscillations produced by an electron tube. It is claimed that damped oscillations must be used for one purpose, undamped for another. But why undamped can not do everything that can be done by electrical waves the surgeons can not tell us—nor can anyone else. It shows that the medical profession has not emerged from the days of a generation ago, when patients were made to believe that galvanic currents had to be used for one purpose, faradic for another. The patient was awed by the doctor's great knowledge. The magic of to-day, if not black, is at times rather dark and sometimes shady. That remark, however, does not apply to the endotherm which has been an important instrument in radio surgery.

GORDON FERRIE HULL

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AGING

Das Problem des Alterns und die Chemie der Lebensvorgange. 2. Auflage. By D. REICHINSTEIN. 420 pp., 16 figs. Zurich: H. Akerets Erben Publishing House. 1940. $9.00.

THE first section of this work presents the conventional summary found in the usual non-critical review of aging. For the most part, the material is old and evidently taken from the familiar German reviews which have appeared in the past. It will prove of little interest to those familiar with the field and of little help to others since it has so few references that the location of the source material will be very difficult.

In the section devoted to the aging of cells, much attention is given to the pigments and the well-known theories of Mühlmann.

After such an introduction physical chemistry is dragged into the field of aging. Great labor is expended in attempting to make physical chemistry encompass the field of aging, but this elusive field constantly seems to escape. The final conclusion of the reader is that much too little is known experimentally about the processes of aging to apply physical chemical theory. The author's attempts are interesting but rather speculative.

Under the section devoted to the chemistry of life processes are discussed such diverse subjects as "Prontosil," choline, certain phases of endocrinology, with some consideration of cellular oxidation and enzyme action. As a whole, the thread of the story is difficult to follow and gives the impression of notes taken by the author on current science which has interested him.

The final section upon the theories of aging affords little that is new and much that could be forgotten.

In general this work neglects modern literature. It lacks the critical approach of such reviews as that of

Professor Carlson in Cowdry's "Problems of Aging." The field covered is very restricted in comparison with the work of Cowdry. The most useful contribution of Reichinstein's work is the presentation of his ideas concerning the possible explanation of aging processes on the basis of classical physical chemistry.

C. M. MCCAY

CORNELL UNIVERSITY

SOCIETIES AND MEETINGS

THE NEW HAMPSHIRE ACADEMY OF SCIENCE

THE twenty-second annual meeting of the New Hampshire Academy of Science was held on May 31 and June 1, at Conway, N. H. At the Friday evening session, several papers were read by members, and a group of short films was shown as a sample of the science titles in the teaching and loan library of films maintained by the University of New Hampshire.

Saturday morning was entirely devoted to a symposium, "The Bedrock Geology of New Hampshire." The introductory paper on methods and history in this rapidly developing field was by Professor Marland P. Billings, of Harvard. There followed five reports of investigation in special regions: Mt. Cube, by Dr. Jarvis B. Hadley, of Tufts College; Mt. Cardigan, by Dr. Katharine Fowler-Billings; Winnipesaukee, by Dr. Alonzo Quinn, of Brown University; the Dover-Portsmouth area, by Dr. T. R. Meyers, of the University of New Hampshire; and the region of Lewiston, Maine, by Dr. Lloyd W. Fisher, of Bates College.

Saturday afternoon was given over to the reading of other papers by members, to the business meeting, and to the address of the retiring president, Dr. George White, of the University of New Hampshire, on "New Hampshire Mineral Resources."

At the business meeting it was voted to award the grant-in-aid for the current year from the American Association for the Advancement of Science to Professor T. R. Meyers, of the University of New Hampshire, for a continuation of his study on the stratigraphy, structure and petrology of southeastern New Hampshire.

It was voted to elect Professor Marland P. Billings, of Harvard, to honorary membership in the New Hampshire Academy of Science "for his extensive and critical studies of New Hampshire igneous, structural and historical geology, and for his example and guidance, which has given rise to a whole 'Billings school' of researchers in New Hampshire geology."

The publication committee reported ready for distribution the academy's Bulletin No. 1, an illustrated 40-page booklet called "Geology of the Presidential Range," by Richard P. Goldthwait.

The following officers were elected for 1940–41: *President,* Professor Bancroft H. Brown, Dartmouth College; *Vice-President,* Mr. Charles D. Howard, State Board of Health, Concord; *Secretary-Treasurer,* Professor W. W. Ballard, Dartmouth College; *Member of Executive Council,* Professor George White, University of New Hampshire, for five years.

The executive council voted to hold the next annual meeting at Durham, in the fall of 1941.

W. W. BALLARD,
Secretary

THE NEW YORK STATE GEOLOGICAL ASSOCIATION

THE sixteenth annual field meeting of the New York State Geological Association opened at Catskill, New York, on April 25, with a preliminary conference attended by about 100 geologists. The field trips on Friday and Saturday, April 26 and 27, were participated in by nearly 300 persons (over 70 cars and buses), including those who elected the special trips offered on Saturday and Sunday.

The annual dinner on Friday evening, with 225 at table, was followed by the business meeting and by talks and moving or color pictures on the local geology, with Dr. and Mrs. Nelson H. Darton as guests of honor. A letter of congratulations to Dr. Herman L. Fairchild on his approaching ninetieth birthday was voted and was signed by a large number of those present. Rochester was chosen as the meeting place for 1941, with Dr. Harold L. Alling for president and Professor J. Edward Hoffmeister secretary. Dr. Alling showed moving pictures in color of the 1939 meeting. Dr. Darton described his experiences in the early mapping of the region and his recollections of the famous men now dead who had worked here. Yates Wilson and John Cook discussed various phases of the geology east of the Hudson. Harry Eaton spoke on Amos Eaton, whose geological career began in Catskill. A set of colored photomicrographs of the local strata was then shown by Dr. Alling, followed by color pictures of Glacier National Park by Dr. Dyson.

A committee to prepare a plan to encourage teaching of geology in the secondary schools was also voted and will be appointed by the new president. Officers for the Catskill meeting were G. H. Chadwick and Robert Weeks Jones. By courtesy of the school authorities, the new Catskill High School building was used as headquarters.

The committee on nominations consisted of Dr. Robert Wesley Brown, Dr. Nelson C. Dale and Dr. Irving G. Reimann.

GEORGE H. CHADWICK

SPECIAL ARTICLES

ALCOHOLIC FERMENTATION BY FUSARIA JUICE OBTAINED WITH A WET CRUSHING MILL

THE study of certain aspects of the mode of action of cell-free yeast juices from the point of view of colloid chemistry was introduced several years ago,[1,2,3] and led, among other developments, to the experimentally established rule that enzymes in juices and within the cell may change their activity in accordance with the degree of dispersion of the accompanying carriers. Miss M. G. Macfarlane[4] presents an impressive, though presumably far from complete list of differences in behavior between the living yeast cell and the so-called cell-free extracts in regard to the mechanism of alcoholic fermentation. The fermenting cell-free juices generally used (prepared according to Buchner, Lebedew or Lipmann) necessarily exhibit partial or complete suppression of activities or losses of a single or several members of the enzyme systems involved. This accounts for the well-known fact that the harmonious order of the living cell and the phase sequence of enzyme action within it become disorganized due, *e.g.*, to dilution, disruption of carrier systems because of possible denaturation, proteolysis, etc.

A cell system which exhibits, beyond doubt, a measurable phosphorylation and subsequent dephosphorylation of carbohydrates during fermentation is that of the Fusaria. It was deemed justified, therefore, to attempt to investigate an artificial enzyme system from *Fusarium lini Bolley* extracted with the aid of the Booth-Green wet crushing mill.[5] This juice, due to the manner of its preparation, could, if found to be at all active, be compared to a large extent with the juice obtained long ago by Dixon and Atkins,[6] but scarcely investigated by them.

After applying a slight mechanical improvement to the mill, we obtained a juice which can be described as follows. It is opaque; its color varies from light yellow to reddish-brown, according to the distribution of the pigment present.[7] Its pH, prepared with water, is in the neighborhood of 5.7 (the internal cell pH of *Fusarium lini Bolley* lies between 6.0 and 6.1[8]); its relative viscosity measured at 25.3° is 1.168, the determination on the juice having been made a few days after preservation at 6°.

The measurable esterifying capacity of the juice at 28°, as determined by the method of Fiske and Subbarow,[9] amounts under our experimental conditions to about 35 to 40 per cent. of the phosphorylation in the living cell system. In some cases this appears to have been preceded by a dephosphorylation of the organic phosphate donators originally present in the living Fusaria cells.[10] The esterification brought about by the quantity of inorganic phosphate present amounted to about 3 to 4 per cent. The quantity of CO_2 obtained by the action of the zymases compared favorably with that of the living system.

Judging from the data available at present, and taking into consideration the fact that the crushing of the cell makes uniform the highly different pH values of closely organized cell particles,[11] the cell-free Fusaria juice obtained with the wet crushing mill seems to have furnished us so far with an enzyme system which does not exhibit deficiencies or distortions of kind or magnitude as compared with the usual maceration juices obtained from yeasts.

JOHN C. WIRTH
F. F. NORD

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NEW YORK, N. Y.

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[1] F. F. Nord, *Trans. Faraday Soc.*, 26: 760, 1930.

[2] *Ibid.*, SCIENCE, 75: 54, 1932.

[3] *Ibid.*, *Nature*, 135: 1001, 1935.

[4] M. G. Macfarlane, *Biochem. Jour.*, 33: 574, 1939.

[5] Booth and Green, *Biochem. Jour.*, 32: 855, 1938.

[6] Dixon and Atkins, *Sci. Proc. Royal Dublin Soc.*, 14 [N. S.]: 1, 1913.

[7] Nord, Hofstetter and Dammann, *Biochem. Zeits.*, 293: 235, 1937.

[8] S. Mahdihassan, *Biochem. Zeits.*, 226: 203, 1930.

[9] Fiske and Subbarow, *Jour. Biol. Chem.*, 66: 375, 1925.

[10] Nord, Hofstetter and Dammann, *Biochem. Zeits.*, 293: 252, 1937.

[11] J. Spek, *Ergebn. Enzymforschung*, 6: 20, 1937.

THE ACTION OF TYPE-SPECIFIC ANTIBODY UPON THE PULMONARY LESION OF EXPERIMENTAL PNEUMOCOCCAL PNEUMONIA[1]

ALTHOUGH the effectiveness of type-specific antiserum in the treatment of pneumococcal pneumonia is well established, the action of antibody upon the pulmonary lesion is not clearly understood. Considerable evidence[2, 3, 4] has been advanced supporting the view that antibody can not penetrate areas of consolidation within the lung. Recently Kempf and Nungester[5] have studied the penetration of antipneumococcal immune bodies into pneumonic lesions produced experimentally in rats. Using both horse and rabbit antiserum, they were unable to demonstrate the presence of antibody in the lungs following intravenous treatment. They concluded that, even were it found to penetrate the consolidated area, the antibody could not be expected to accumulate in sufficient concentration to neutralize the pneumococcal polysaccharide present in the alveoli.

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[1] Preliminary report.

[2] B. S. Kline and M. C. Winternitz, *Jour. Exp. Med.*, 21: 311, 1915.

[3] T. T. Wang and C. M. Van Allen, *Proc. Soc. Exp. Biol. and Med.*, 30: 814, 1933.

[4] J. P. Fox, *Jour. Immunol.*, 31: 7, 1936.

[5] A. H. Kempf and W. J. Nungester, *Jour. Infect. Dis.*, 65: 1, 1939.

Nye and Harris,[6] studying human autopsy material, have reached the same conclusion.

The purpose of this paper is to report preliminary data which demonstrate that antipneumococcal immune bodies not only enter the pneumonic lesion but do so in sufficient amounts to limit its spread. The antibody is shown to cause agglutination of the pneumococci within the alveoli and to promote rapid phagocytosis of the organisms by the cells of the pneumonic exudate.

Experimental lobar pneumonia was produced in white rats by inoculation of the left main bronchus with encapsulated Type I pneumococci[7] suspended in mucin. The method of Nungester and Jourdonais,[8] modified to increase the severity of the disease, was used in all experiments.[9] The pneumonia produced was uniformly fatal, killing all of 38 untreated rats in less than 5 days. Half of the animals died within 48 hours. In only 4 rats was the lesion confined to the left lung, and all but 1 developed pleurisy, pericarditis, or both. All had bacteriemia at the time of death.

The pathogenesis of the pulmonary lesion was studied by examining the lungs of 35 rats killed at various intervals following inoculation. The pneumonic process was seen to spread rapidly until nearly the entire left lung was involved in 36 hours. Frequent blood cultures showed invasion of the blood stream in roughly half of the animals after 12 hours and in over 90 per cent. at the end of the first day. The lungs of each rat were fixed in Zenker-formol solution according to the method of Loosli,[10] and sagittal sections of the single-lobed left lung were stained by the Gram-Weigert technique. The most striking feature of the spreading lesion was the presence of the edema zone[11, 12] at the advancing margin. The pneumococci were seen to be most numerous in this region and histological examination of the lungs at intervals from 12 to 36 hours revealed that the pneumococci spread into normal alveoli principally by way of the edema fluid.

The action of type-specific antibody upon the advancing lesion was observed in rats treated 2, 6, 12 and 18 hours after inoculation. One cc (6,000 units) of concentrated antipneumococcal rabbit serum[13] was injected into the femoral vein of each animal in a single dose.[14] The rats were killed in groups of 3 at 1, 6, 18, 42, 96 and 168 hours after treatment; the lungs were fixed and stained by the methods already described. No deaths due to pneumonia occurred among the 76 treated animals, in spite of the fact that many had already developed bacteriemia at the time of treatment. The bacteriemia cleared following therapy and autopsy findings indicated that the pulmonary lesion had been promptly arrested by the serum. The margin of the consolidated area was seen in the gross to become sharply demarcated 6 to 18 hours after treatment, in striking contrast to the irregular hemorrhagic border characteristic of an advancing lesion. Microscopic examination showed pronounced agglutination of the pneumococci, particularly in the edema zone, within an hour. Organisms with swollen capsules were noted frequently. Following agglutination of the pneumococci, the pneumonia failed to spread as evidenced by narrowing of the edema zone at 6 hours and its disappearance after 18 to 42 hours. The agglutination of the organisms in the edema zone appeared to prevent them from invading new alveoli and thus apparently allowed leucocytes to overtake them at the margin of the lesion. Marked phagocytosis of pneumococci by the polymorphonuclear leucocytes was noted at 6 hours and few, if any, organisms could be found, either extracellularly or intracellularly, after 96 hours. The macrophage reaction[15] became prominent in 4 days, and at the end of one week there was extensive clearing of the exudate.

CONCLUSIONS

Type-specific immune bodies contained in antipneumococcal rabbit serum, when administered intravenously in sufficient quantity, enter the pneumonic lesions of rats with experimental pneumococcal pneumonia. The antibody agglutinates the pneumococci free in the alveoli and thus apparently stops the spread of the pneumonic process. Clumped cocci can be seen throughout the involved area, but particularly in the edema zone at the advancing margin of the lesion. The presence of antibody within the alveoli is likewise revealed by the "Quellung" phenomenon and by a marked increase in the phagocytosis of organisms by the cells of the alveolar exudate.

The author is indebted to Dr. J. F. Enders for much helpful advice, and to Mr. John Burke for the preparation of microscopic sections.

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HARVARD UNIVERSITY MEDICAL SCHOOL

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[6] R. N. Nye and A. H. Harris, 2nd, *Am. Jour. Path.*, 13: 749, 1937.

[7] A5 strain, kindly supplied by Dr. O. H. Robertson.

[8] W. J. Nungester and L. F. Jourdonais, *Jour. Infect. Dis.*, 59: 258, 1936.

[9] Details of the method will be described in a later publication.

[10] C. G. Loosli, *Arch. Path.*, 24: 743, 1937.

[11] O. H. Robertson, L. T. Coggeshall and E. E. Terrell, *Jour. Clin. Invest.*, 12: 467, 1933.

[12] F. D. Gunn and W. J. Nungester, *Arch. Path.*, 21: 813, 1936.

[13] Obtained through the courtesy of Dr. W. G. Malcolm of the Lederle Laboratories.

[14] Subsequently, smaller amounts of antibody were used with similar results. As little as 120 units was found to be effective in rats treated 12 hours after inoculation.

[15] O. H. Robertson and C. G. Loosli, *Jour. Exp. Med.*, 67: 575, 1938.

* Fellow in the Medical Sciences of the National Research Council.

GROWTH RESPONSE OF PLANTS TO RIBOFLAVIN AND ASCORBIC ACID

EXPERIMENTS at the University of Iowa on mineral nutrition of plants, involving the addition of riboflavin and ascorbic acid, have disclosed certain marked responses to these vitamins. Data are given for replicate pot cultures of eggplant (*Solanum melongea*, variety Black Beauty) and tobacco (*Nicotiana tobaccum*, variety Little Turkish) grown in silica gravel with Withrow's nutrient solution. Controls received only mineral salts while test cultures of the eggplant were supplemented with 2.5 P.P.M. synthetic (Merck) riboflavin, and those of tobacco were supplemented with 10 P.P.M. synthetic (Merck) ascorbic acid, dissolved directly in the aqueous solution. Pots were drained on alternate days and fresh nutrient solution added to maintain a uniform supply of mineral salts and vitamins.

Data (Table I A) show that riboflavin increased the growth of eggplant and (Table I B) that ascorbic acid increased the growth of tobacco.

TABLE I

A. GROWTH RESPONSE OF EGGPLANT IN NUTRIENT SOLUTION CONTAINING RIBOFLAVIN

Age of plants in days	Stem length, cm.		Fresh weight of tops in gms.		Per cent. dry weight		Fresh weight of roots in gms.		Per cent. dry weight	
	Control	Test	Control	Test	Control	Test	Control	Test	Control	Test
56	6.2	12.1	13.5	45.5	17.5	12.3	1.6	3.0	14.0	20.2
77	7.1	14.2	48.5	121.0	12.7	12.3	12.5	22.9	9.9	9.4
B. GROWTH RESPONSE OF TOBACCO IN NUTRIENT SOLUTION CONTAINING ASCORBIC ACID										
56	25.1	34.2	38.2	82.8	8.2	8.1	3.0	5.9	12.1	16.3

The initial gain of eggplants receiving riboflavin was maintained throughout growth. The leaves were consistently coarser in texture, thicker, and darker in color than the controls. The roots were coarser and more extensive. Shoots of 56-day-old riboflavin plants were more highly hydrated (dry weight 12.3 per cent.) than controls (dry weight 17.5 per cent.), but the converse relationship existed in the roots (dry weight of riboflavin plants 20.2 per cent., controls 14.0 per cent.). These differences in percentage of dry weight tended to level out in both tops and roots with increasing age. At the age of 77 days the dry weight of tops of both test and control plants was approximately 12.5 per cent. and of both sets of roots about 9.5 per cent.

In most respects the tobacco plants receiving ascorbic acid showed gains in growth comparable to those of the eggplants receiving riboflavin. Hydrogen ion determinations of the press sap showed that riboflavin increased the acidity of the apices of the eggplant, while with the ascorbic acid there was a slight decrease in the acidity of the stem tips of the tobacco plants. The plants receiving the vitamins showed smaller pH variations of the different regions than in the controls. Initial gains due to the two vitamins were maintained throughout the experiment. Compositional differences persisted in mature plants even where gross external contrasts tended to disappear.

The data suggest definite species differences in response to riboflavin and ascorbic acid, as well as the marked stimulatory effect of riboflavin which has not been previously reported. The experiments are being continued to determine the exact character of the histological and metabolic differences in various species under the influence of riboflavin and ascorbic acid.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF PLASTIC AS A SUBSTITUTE FOR COVER GLASSES

As a result of the present conflict in Europe, the price of cover glasses used in the preparation of slides for the microscopic study of tissues has risen so much that the question as to how to meet this increase in price has become a serious problem for those laboratories in which the number of tissues studied in serial sections is great. There seems, accordingly, to be a widely felt need for a less expensive substitute for imported cover glasses. We have found that plastic serves for this purpose.

The use of plastic as a substitute for cover glasses in microscopic technique is not new, since Lentze[1] had recommended similar material about ten years ago. However, some difficulties are encountered in the covering of microscopic sections with plastic, which seem so far to have prevented the wider use of this material; but it is possible to overcome these difficulties to a very large extent and we wish therefore to describe the method which we have found to be satisfactory.

We are using cellulose acetate, trade name "Vue Pak,"[2] which can be obtained in sheets 0.005 inch or 0.127 mm thick, corresponding approximately to the thickness of cover glasses No. 1, which varies between 0.13 mm and 0.14 mm. The refractive index of this material is 1.49 to 1.50, which is very nearly that of glass. Resistance to heat is 140–180° F. Exposure of the mounted and dried slides first to a temperature of 110–115° F. for twelve hours, then keeping them at room temperature for another twelve hours, with a repetition of this procedure on several days, left them unchanged. The effects of sunlight, weak acids and weak alkalies are very slight.

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[1] H. Lentze, *Klin. Wochenschr.*, 9: 1470, 1930.

[2] "Vue Pak" prepared by Monsanto Chemical Company.

The plastic is obtained in sheets which can be cut in such a way that their size and shape are the same as those of cover glasses. These slips are kept covered on both sides with sheets of tissue paper. They are, as a rule, clean, but if cleaning should be necessary, they may be dipped in 50 per cent. alcohol, one at a time, and dried immediately. Thick, paper-filtered Canada balsam serves as mounting medium. The use of an excessive amount of xylol should be avoided.

The most objectionable feature in the use of plastic in the place of cover glasses is their tendency to "curl" during the process of drying. If the slips are kept in the oven overnight at a temperature of 37° C., from three to five per cent., sometimes even a larger number, of the cover slips may pull away at the edges. To overcome this difficulty as much as possible it is necessary, after mounting, to dry the slides slowly at room temperature for five to six days, in order that the Canada balsam may be well hardened before placing the slides into slide boxes. In this way as a rule a fairly satisfactory result is obtained, although the smoothness of the plastic is not always equal to that of cover glasses.

After the appearance of the article by H. O'Brien,[3] we substituted isobutyl methacrylate polymer for Canada balsam. The solution found suitable was approximately 1 part of isobutyl methacrylate polymer[4] to 2½ parts of xylol. These experiments are still in an early stage, but it seems that this change improves the results. Under these conditions the drying requires not more than one day and, so far, no curling of the plastic cover slips has occurred.

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ERRATIC POTENTIALS OF ELECTRODES SEALED IN GLASS TUBING

Our attention has been drawn to the erratic potentials that are observed in the potentiometric titration of dilute solutions in which platinum electrodes, sealed in glass tubing, are used. These erratic potentials were particularly obnoxious near the end point of a titration. We have noted them specifically in the potassium dichromate-stannous chloride and the thallous chloride-potassium iodate titrations. Complete elimination of this erratic behavior was obtained by removing the glass tubing from the electrode, or, by allowing only the wire (electrode) to touch the solution being titrated or the electrolyte of the cell being studied.

A general investigation has indicated that the erratic behavior of electrodes sealed in glass tubing is much more prevalent than one would normally be led to believe is true. Apparently most observers have attributed the erratic potentials to some peculiarity of the reaction involved rather than to the physical structure of the electrode assembly. Particularly does this seem to be a source of trouble in the erratic behavior of certain E.M.F. cells built for special purposes. This phenomenon may be crucial in these cases, for not only are fluctuation or drifts introduced but the induced potentials may be large (300 mv) and irreproducible.

The cause of this trouble has not been entirely established. It may be due, partially or entirely, to strains in the electrodes as a result of the glass-metal seal. This may result in a variable junction potential as a result of the solution being in contact with the same metal in different standard states; this could be reduced to a constant value or eliminated by a very careful annealing process. The disturbance is definitely in the region of the glass-metal-solution interface. Elimination of this interface seems to eliminate the source of trouble. In potentiometric titrations, where the electrodes must be subject to frequent cleaning by burnishing in a flame or treatment with hot aqua regia, we have found it highly desirable to eliminate the glass casing for the electrodes or to construct the electrode in such a manner that the solution does not come into contact with the metal-glass interface. This may also be necessary for many other types of cell measurements. Our recent experiences with this phenomenon have been such that we are certain that it is of a general nature and requires consideration where cell data are being obtained.

A. B. Garrett
Ernest Hogge
Ray Heiks

The Ohio State University

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Boucher, Paul E. *Fundamentals of Photography.* Pp. xi + 304 + lii. Illustrated. Van Nostrand. $3.00.

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Fearon, William F. *An Introduction to Biochemistry.* Second edition. Pp. xii + 475. Mosby.

Hessel, F. A., Wellford Martin and M. S. Hessel. *Chemistry in Warfare.* Pp. x + 164. Illustrated. Hastings House, New York. $2.00.

Shriner, Ralph L. and Reynold C. Fuson. *The Systematic Identification of Organic Compounds.* Second edition. Pp. xi + 312. Wiley. $2.75.

Smiley, Dean F. and Adrian G. Gould. *A College Textbook of Hygiene.* Third edition. Pp. xiii + 589. 131 figures. Macmillan. $2.50.

Steeds, W. *Mechanism and the Kinematics of Machines.* Pp. xi + 319. 379 figures. Longmans, Green. $5.00.

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[3] Harold C. O'Brien, Science, 91: 412, 1940.

[4] The isobutyl methacrylate polymer prepared by du Pont Company.

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THE TIME-SCALE OF THE UNIVERSE[1]

By Dr. HENRY NORRIS RUSSELL

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IT is beyond our power—and may be beyond the bounds of reason—to specify the age of the material universe precisely, like an old epitaph: "Aged 82 years, 6 months and 17 days." But human life has not only an individual duration, but a general time-scale. Only under exceptional circumstances does a man change greatly in thirty days—and rarely does he fail to change greatly in thirty years. There are, therefore, more than astronomical reasons for measuring our ages in years—they afford a scale commensurate with the changes which accompany them.

It is certainly legitimate to inquire, Can we set up a similarly rational time-scale for the description of natural phenomena in the large? Will the units of this scale be thousands of years, or millions, or billions, or greater? and will different scale-units be appropriate for different ranges of phenomena—just as the rapid development of a child in his first year makes it reasonable to give his age in months?

In my student days, at the turn of the century, no definite answer could be given to these questions. We had very strong reasons indeed to believe that millions, rather than thousands, of years formed an appropriate scale for the greater geological processes; but there was no trustworthy evidence concerning how many millions of years were involved.

We realized, too, that, unless wholly unknown forces or influences of some sort were imperceptibly at work, the history of a finite material universe must run its course in a finite interval of time. This conclusion was based upon the one physical principle which has withstood unchallenged the revolutionary changes of the subsequent forty years—the Second Law of Thermodynamics. The energy in such a universe is indestructible—though, as we now know, capable of reversible transformation into mass. But it is steadily becoming less available. Water runs, and stones roll, down-hill, and this tends, in the long run, to flatten out the high spots and fill up the low ones. Heat is carried by conduction or radiation from hotter bodies to colder ones. In a thousand other ways, also, nature tends toward mediocrity—a dead level of uniformity and quiescence. There may be other forces—such as the deep-seated ones which build mountains—which, for a time, apparently arrest or reverse the downward tendency, but these draw on other stores of energy—which must be finite in amount—and diminish their availability, so that at long last mediocrity reigns.

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[1] The ninth James Arthur Lecture, delivered at New York University, May 14, 1940.

This conclusion is unpleasant to most people; but it is supported by the tremendous weight of the Law of Averages. The argument is really simple enough. Suppose we had 10,000 smooth, spherical grains of white sand—all indistinguishably alike in size, shape and weight—and 10,000 more, exactly like the others except that they were black. Pour the white sand carefully, then the black sand cautiously on top of it, into a glass globe of such a size that it is still only half full. Then shake the globe. After a good shaking we will get a grayish mixture. Keep on shaking. What is the chance that by mere luck the white sand will some time all get on the right hand side of the globe and the black on the left? No elaborate analysis is needed to give the answer: it just naturally won't happen. Of course, if the white grains were lighter than the black, shaking would bring them to the top like cream; but we have expressly assumed that this is not so: the two kinds of grains are indistinguishable except by color, and the color makes no difference to the effects of shaking.

The interesting configurations of the material universe, with mountains and valleys, hot and cold bodies, etc., turn out, upon further analysis, to be comparable to interesting configurations of the sand—say a sand-painting on the gray surface. The fault of the analogy is that "shaking" is a catastrophic process, while conduction, radiation, etc., act gradually. But the conclusion that the interesting configurations tend to run down to undistinguished mediocrity is true for both. Technically, this is called an increase of entropy. We shall not be far wrong if we think of it as an increase of mediocrity or of dullness.[2]

Two conclusions follow. First, as regards the future, the universe bids fair, by an overwhelming probability, to become gradually less and less interesting. The approach to the final state of deadly dullness is likely to be asymptotically slow, but sure.

Second, while we can reason thus about the remote future (on the assumption that known natural laws are alone operative) we can not do the same about the past. A homely illustration of Lord Kelvin's comes to mind. Suppose that, in an open field, I pick up a stone so hot that I drop it instantly. I can figure out how long it will take to cool; but all I can say with certainty about the past is that, not so long ago, it has been in a hot place. I can calculate that if it has been lying in the field an hour it had then a certain surface temperature, if two hours, a much higher temperature, and so on, but I can not find out how or when it was heated without further information.

The stars, unlike the stone, are what an ingenuous student of mine once, on an examination, called "self-heating bodies"; but, with suitable changes, the analogy is still valid. We can carry our analysis of the past—a sort of reversed prediction—back a long way, but not forever. Sooner or later our calculations, based on the assumption that the ordinary, vastly probable, processes of "running down" have been continually at work, reach a limit, and we can go no farther back.

It would be unsound to conclude that there must have been some specific intervention of other influences or forces.

In any statistical system—like the globe full of sand-grains—any possible configuration must occur, again and again, in a sufficiently great number of trials, provided the effects of shaking (or its equivalent) are really at random. The universe is at present in a very interesting and improbable state, but this does not *prove* that it may not have got into this state by mere accident.

In a *very* long time, such as $10^{10^{100}}$ years, almost anything may happen. This argument has been clearly stated by J. B. S. Haldane, who caps it with the epigram: "The correct deduction from the Second Law is not that the present state of the universe could not have happened by chance, but that most of eternity is dull."

This we knew, in a general way, forty years ago; but the evidence that the material universe is in a transitory state is far more impressive now than it was then. From the nuclei of atoms to the remotest galaxies, we find irreversible changes—a one-way progress. In several cases we can measure or estimate the time-rates of these changes; and one of the most remarkable results of modern physics is that these independent paths of approach lead to the same result. The time-scale, from atoms to nebulae, is measured in billions of years[3]—millions are far too small, trillions much too great. Some of this evidence I will try to summarize, necessarily in brief, without entering upon many fascinating by-ways.

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[2] I have elaborated this illustration to bring out the importance of the *intrinsically indistinguishable* character of the individual grains—an essential element which has been inadequately stressed in some discussions of the subject. If each grain were marked with a number, and we recorded the position of every one in the gray mixture, and then shook it vigorously, the probability that grain 8392, and every other grain, would come back to the same position it had before would be even less than the chance that all the white grains would be found on *one* side.

RADIOACTIVITY AND THE AGE OF THE EARTH

(1) Among the major modern discoveries is that atoms of many sorts are unstable and subject to spontaneous disintegration. The atomic nucleus (which automatically clothes itself with electrons enough to build up the rest of the structure) may eject a portion of itself, and settle down into one of a new kind, differing in charge, in mass, or in both. More than twenty such unstable atoms occur naturally, and hundreds of others have been made artificially by bombardment with particles of high energy. With the latter we shall deal later; at present we have to do with the former. These fall into three series commonly called after their most prominent members, radium, actinium and thorium. Each series starts with an almost stable atom, so that only a very small fraction of those present disintegrate in a year. By the delicate and precise technique of radioactive measurements—of which there is no time to speak here—these fractions have been determined with considerable accuracy. Heavy uranium (the abundant isotope U_{238}, of atomic weight 238) loses by spontaneous change, during one year, one out of 6,570 millions of the atoms originally present; light uranium, or actino-uranium, U_{235}, one out of 1,030 millions, and thorium, Th_{232}, one out of 20 billions.[4] The transformed atoms are far less stable, and go in each case through a long series of changes, in some of which alpha-particles (helium nuclei) are ejected, and in others electrons. At last each series ends in a stable nucleus—all three of them isotopes of lead, of weights 206, 207 and 208, respectively. Some of the intermediate products have lives of about a million years; others last only a minute fraction of a second. In all cases, the rates of radioactive change can not be altered perceptibly by any external influence that has been brought to bear. High temperatures and pressures are utterly without effect; and even the drastic process of bombardment with high-speed particles—though it may transform the nuclei which are directly hit into something quite different—has no effect on those which are missed.

On the time-scale with which we have to deal these changes may all be regarded as very rapid, and we may forget the intermediate stages, and talk as if each parent element turned directly into lead, without introducing error into our calculations.

If, now, a uranium-containing mineral is left alone in the rock for a billion years, about 15 per cent. of the atoms originally present will have broken down—to be more precise, 14 per cent., since toward the end there are fewer left to disintegrate than at first. Corresponding to these, an equal number of atoms of lead will have been produced. Their weight will be 12 per cent. of that of the uranium originally present, or 14 per cent. of those remaining—the other 2 per cent. representing helium given off during the process. The older the mineral, the more lead there will be, and from its ratio to the uranium we can find how long the crystal has been undisturbed.

Certain obvious corrections are necessary. If thorium is also present, we must allow for the lead which it has produced at the same time. Actino-uranium is always present to the extent of 1/140 of the heavy uranium, and may easily be allowed for. We must be sure that the crystal has not been altered chemically—for example, by the action of percolating water—during its long entombment in the rock. Hence, only the inner portions of clean crystals, showing no visible effects of this sort, are employed. Finally, how can we be sure that there was not some lead in the crystal when it was formed?

Nature is kind to us here. We can measure, with the mass-spectrograph, the relative amounts of lead of atomic weight 206, 207 and 208. "Ordinary" lead contains also a small proportion of another isotope, of weight 204, which does not appear to be produced by radioactive processes. Measuring this, we can determine and allow for the ordinary lead which may have been present at the start.

With these precautions, the radioactive method for determining the age of minerals appears to be thoroughly reliable. It is applicable mainly to igneous rocks, and gives the time since they solidified. The geological age of such rocks can usually be determined by a study of the neighboring strata. In this way many points of the geological sequence can be dated, and the agreement with the order of succession indicated by the stratigraphic and paleontological evidence is admirable.

We are concerned to-night with the greatest ages this revealed, and these run up to 1,500 or even 1,800 million years. The most striking example is a pegmatite in Manitoba, in which have been found crystals of uraninite containing uranium, of monazite containing thorium, and of mica containing rubidium. This is also radioactive, and breaks down very slowly into an isotope of strontium. The ages determined independently from these three minerals and based on different radioactive processes, come to 1,600, 1,900, and about 1,700 million years.

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[3] In the customary American notation, 10^9 years, not 10^6 or 10^{12}.

[4] A. O. Nier, *Phys. Rev.*, 55: 153, 1939; A. F. Kovarik and N. I. Adams, *Phys. Rev.*, 53: 928, 1938.

There seems to be no escape from the conclusion that these minerals had actually been lying undisturbed in the rock for more than a billion and a half years, until the miner blasted them out. The Earth must be at least as old as this.

The same radioactive processes may be used to find an upper limit to the age of the Earth, or at least of its crust. Radioactive tests are so delicate that we can find, with considerable accuracy, the amounts of uranium and thorium which are present per ton of rock, and hence, taking an average of rock-types, for the upper crust of our planet. The amount of lead must be found by ordinary chemical methods, but is fairly well estimable. Now, so long as the Earth's crust *as a whole* has not been mixed with other matter, the lead produced by the decay of the uranium and thorium must still be in it. A simple calculation shows that all the existing lead would have been produced radioactively in between three and four billion years. This figure is considerably less accurate than the last; but it should represent a true upper limit, as there was very probably "ordinary" lead present. Provided that the amounts of uranium, thorium and lead are well determined, this calculation holds, no matter how many times the material of the crust may have been melted or re-worked, so long as no process selectively removed the uranium or the lead into the inaccessible interior of the earth. It appears, then, that the earth's crust is more than 1¾ and less than 3½ billions of years old.

That so great a time-interval can be determined within a factor of two is remarkable.

If all the helium which is produced by radioactive changes within a mineral remained in it, measurement of its amount would serve to determine its age. If some of the gas escapes—as it is likely to do except from dense crystals or fine-grained rocks—the calculated age will be too low. This method, applied to terrestrial minerals, gives ages comparable with the lead-ratio methods, or lower.

Paneth has employed it upon meteorites, finding low values in some cases (as might be expected) and maximum ages up to 2,800 million years for others. The recent researches of Whipple at Harvard show that several bright meteors which have been accurately observed by photography were moving around the sun in asteroid-like orbits before they hit the earth. These meteorites may then be regarded as members of the solar system—though there is a chance that a small percentage were visitors from interstellar space.

The age of the earth appears therefore to be substantially the same as that of the solar system as a whole (so far as we can test it).

At this point we lose the powerful aid of chemical analysis. Theoretically we might hope to detect uranium, thorium and lead spectroscopically in the Sun, or even the stars. Lead has actually been found; but unfortunately the character of the spectra of uranium and thorium, which contain great numbers of rather weak lines, makes the spectroscopic test in the Sun relatively insensitive, and no evidence is available.

(2) A determination of time-scale of a radically different sort may be made from observations of the extra-galactic nebulae (or external galaxies, as some prefer to call them). The brilliant work of Hubble has proved that these objects are enormous clouds of stars, thousands of light-years in diameter, and, except for the very nearest, millions of light-years away. The distances of the nearer ones can be determined satisfactorily, by a study of the brightness of individual stars within them, especially of variable stars of the Cepheid type, and in this way Hubble has found the distribution of size and brightness among the members of the nearest of the great clusters in which these nebulae often congregate. On the reasonable assumption that the average brightness and the range about the average is similar from one cluster to another, the distances of faint clusters can be derived, some of them as great as 300 million light-years.

The spectra of these nebulae are what might be expected from a cloud of stars; but their spectral lines show a "red-shift" which increases steadily with increasing faintness and distance. This shift is of exactly the kind which would be produced by the Doppler effect due to a very rapid recession. The velocities thus derived are far greater than any previously known, and attain the enormous value of 42,000 kilometers per second for members of a cluster in Ursa Major, whose distance is estimated at 240 million light-years. The observations of these spectra, which have been made mainly by Humason, demand the 100-inch telescope, a specially designed spectrograph of very great light-power, and great skill and assiduity. Spectra have been photographed for nebulae too faint to be directly seen even with this greatest of telescopes—the necessary guiding being done with the aid of a nearby star, whose position, relative to the nebula, had been measured on long-exposure photographs and allowed for.

Hubble has shown conclusively that, in general, the velocity of recession of a nebula is proportional to its distance, a nebula one million light-years away having a velocity of 162 km/sec, etc. There are moderate outstanding differences for the separate nebulae, which presumably represent their "peculiar" or individual motions; but these do not at all obscure the general trend.

This proportionality between velocity and distance may be expressed as follows. If the nebulae could all have been collected at one point at a certain time in the remote past, and each one launched into space in its present direction, and with its present speed, they would all, at the present time, have reached their observed positions and distances. We can not, of course, be sure that their actual motions have continued at a uniform rate; but the assumption that they have gives a time-scale appropriate to the description of these motions. Making the simple calculation we find that the hypothetical starting-time comes to 1,840 million years ago.

The agreement of this with the calculated age of the earth or of the solar system is very striking, since it is absolutely unforced. The two calculations have no data whatever in common, and their results might just as well have disagreed by a factor of ten, or even a hundred, as have agreed, as they do, within a factor less than two.

The interpretation of these red-shifts leads us far into the field of general relativity. According to this space itself, if it contains matter, will usually not be in a steady state but may expand or contract—the matter moving, too. The observed red-shifts are explicable if the universe is now expanding. Many different courses of change are mathematically possible: Space may have once been much smaller than at present, with the stars (or whatever they were if they had not yet begun to shine) close together; or it may have expanded, at first slowly, then faster, from a finite original size smaller than at present. In the future it may continue to expand indefinitely, or reach a maximum "size" and then contract again. With our present limited knowledge, we can not rule out any of these possibilities. When certain data regarding the numbers and distribution of nebulae down to the faintest limit observable with the 200-inch telescope become available, it may be practicable to specify which type of solution fits the more accurately known facts.

In the meantime, the most interesting solution is that of Lemaître, according to which the whole universe was once packed into a narrow compass. He goes so far, a little speculatively, as to envisage a state in which all matter formed one gigantic atom, which broke up and threw off the raw materials for millions of galaxies, and millions of billions of stars. The principal attraction of this scheme is that it pictures a short but tumultuous time in the early days of our present universe, during which all sorts of things which never can happen now might have occurred—such as the origin of the planetary system, and—as we shall see later—the formation of the heavy radio-active atoms.

The interval since these "fireworks," as Lemaître once called them, should be of the order of the 1,800 million years already calculated—perhaps shorter. This makes the earth and all parts of the visible universe contemporaries, and less than two billion years of age.

(3) Objections to this "short" time-scale have been raised by various investigators. Some have proved to be unfounded, but one, suggested a dozen years ago by Jeans, deserves our consideration.

The orbits of binary stars of long period (decades or centuries) are usually highly eccentric, while those of close pairs with periods of months or days are usually nearly circular. So long as a double star remains isolated in space, the relative orbit of the components will be unaltered. If another stray star should pass near it, but at ten times the distance of the close pair, its attraction, being somewhat greater on one component than on the other, would alter the orbit, but not seriously. But if the intruder passed nearer to one of the stars than its companion was at the time, the perturbation due to its attraction would be large and might produce great alterations in the orbit. Sometimes the new orbit would be more eccentric than the old, and sometimes less: But Jeans has shown that the net effect of a great number of such encounters would be to make the average orbital eccentricity 0.66, with a wide range in the individual values.

The actual mean eccentricity for pairs whose orbits have been computed, which can usually be done only if their periods are less than three or four hundred years, is about 0.5, but there is evidence that for the wider and slower moving pairs it increases to about Jeans's value.

For short periods of months or less, the intruding star would have to come far closer to alter the orbit to the same degree. Such close approaches will evidently be much less likely than the wider ones which are effective for the slow pairs, hence, given time enough and not too much, the orbits of the wide pairs should be pretty well "knocked about" while the close pairs are still little affected.

With the present density of distribution of the stars in space, and their present velocities, this production of eccentric orbits should be an exceedingly slow process. Jeans estimates that to get it well toward completion would require 5 trillion years (5×10^{12}).[5]

This leads to a time-scale a thousand times as long as the one we have previously met. The argument is based on sound mathematical analysis, but also on an assumption—that the binary orbits got their high eccentricities in this way. It has been completely upset by the application of just the same reasoning to another class of stellar systems, namely, the moving clusters.

The star-group of the Hyades in Taurus—recognized and known by this name since classical antiquity—contains about 300 stars distributed within a region some forty light-years in diameter, which are moving together in space, in the same direction, and at the same rather rapid rate. Such community of motion can not possibly be an accident. No one doubts that the cluster stars have a common origin, and that they have been moving together indefinitely long in the past. The attraction of the stars on one another must hold the cluster together, but this is so small that if the cluster were isolated in space its outer stars would take 50 million years or more to revolve around the center.

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[5] "Astronomy and Cosmogony," p. 322. Cambridge, 1928.

Expressed otherwise, it is only about a millionth part of the attraction which the components of a wide binary pair (with separation 100 times that of the earth from the sun) exert upon one another. The disturbing force due to a star passing by at a fairly considerable distance, although small compared with the mutual attraction of a binary pair, would often be great enough to set the cluster star (or the binary pair together) in motion at such a rate that it would escape entirely from the attraction of the cluster and be lost to it.

This is effectively an irreversible process. One interloping star *might* meet another interloper under such circumstances that after their encounter one of them was left moving so slowly relative to the cluster's center that it would be "captured"; but the probability of this is infinitesimally small.

All moving clusters must therefore be gradually disintegrating as their members are removed, one by one. The process is slow; but it must be far more rapid than the alteration of the far more firmly bound binary orbits by similar encounters. Hence, if the latter had taken place to any considerable extent, sparse clusters such as the Hyades, and denser ones like the Pleiades, too, would have been completely disrupted into apparently unrelated stars.

The clusters are there in the sky; and some, such as the Hyades, contain typical binary stars with eccentric orbits. The conclusion is unescapable that the double stars have not had enough knocking about to produce the eccentricities of their orbits (which must have originated in some other way not yet understood) and hence that they have not been subject to encounters for anything like the trillions of years which Jeans suggests.

A detailed analysis by Bok[6] shows that there is a second force tending toward the disintegration of a moving cluster, which is usually more effective than the chance encounters already discussed, namely, the tidal effect due to the attraction of the great mass of stars at the center of the galaxy. He calculates that the Hyades will apparently resist this influence, without much change, for two billion years to come, but that, within a billion years more, the cluster will be completely dissipated. A denser and more massive cluster like the Pleiades should last ten times as long.

These numerical calculations are based upon data entirely independent of any which entered into the earlier discussions. The analysis deals this time with the future, not with the past, but once more it leads to a time-scale measured in billions of years.

(4) There is still one more time-scale which we have to consider—that of the life of a star as a luminous body. The main principles of this study were developed by Eddington between fifteen and twenty years ago. A large mass of matter in space—anything more than 100,000 times as massive as the Earth—must have an enormous pressure in its interior, owing to its own gravitation. To withstand this pressure without collapse, the material must be at a very high temperature, millions of degrees, except for a few stars of exceptionally great size. Hence, the matter must be gaseous and highly ionized, with most of the electrons knocked off the atoms. The properties of matter in this state are much simpler than in any other, so that a general theory of the internal constitution of the stars becomes possible.

Since the inside is hotter than the surface, heat must leak out from the interior down the temperature gradient; and it is this which keeps the stars shining. The opacity of the gas can be determined by modern atomic theory, and hence the total energy radiation from the star's surface—its luminosity—may be calculated. It is found that the luminosity increases very rapidly with the star's mass—rather faster than its fourth power, on the average. For the same mass, it changes but slowly with the star's size (inversely as the square root of its radius). Differences in the internal density distribution—the "model"—make surprisingly little difference in the luminosity, hardly more than one stellar magnitude. The chemical composition makes little difference, too, except for the abundance of hydrogen. A mass of almost pure hydrogen is cooler than one composed mainly of heavy atoms, and its luminosity will be less by fully six magnitudes—a factor of 300.

Applying this to the sun, Strömgren finds that the calculated and observed luminosities agree if hydrogen forms 36 per cent. by weight, of the interior mass, the rest being heavy elements.

The principal point of all this for us now is that a large mass, isolated in space, has *got* to shine, to be a star, and to disperse enormous stores of energy into the unknown depths of space.

The only source known to the older physics from which this could be derived is the gravitational energy of the star itself. A steady contraction, too slow to be detectable within the few centuries of exact observation, would draw from this enough to keep the sun shining. But the whole store of energy which could have thus been available to the sun in the past is easily calculable; and it is only enough to supply the present rate of radiation for 15 million years.

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[6] Harvard College Observatory *Circular* No. 384, 1939.

Here is a short time-scale with a vengeance. There must be some way out; and this way, suggested on general principles by various astrophysicists twenty years ago, has just been established on a basis of experimental physics. Relativity predicts that mass and energy should be interconvertible; and many nuclear reactions have been observed in the laboratory in the last few years in which the diminution of the combined masses of the interacting nuclei, and the appearance of the corresponding amount of energy, have been observed. The great energy-liberating process is the building up of hydrogen into heavier elements. The transformation of four atoms of hydrogen into one of helium, for example, diminishes the mass by 1 part in 135.

Now the sun's energy-radiation is known, and it corresponds to a loss of mass of 4,200,000 metric tons per second, corresponding to the transmutation of 570 million tons of hydrogen into helium per second. This is a prodigious amount, but, at 36 per cent. of the whole mass, there is enough hydrogen in the sun to last 40 billion years at this rate—so that we now get a rather long time-scale.

The process by which this transmutation takes place has been identified in detail by the theoretical and experimental work of Bethe. Hydrogen nuclei (protons) colliding with a carbon nucleus, under suitable conditions, build it up into the heavier isotope. Collisions with this again build first the lighter, then the heavier isotope of nitrogen, and collisions with the last split off an alpha particle (helium) and leave a carbon nucleus ready to begin again. Electrons or gamma rays are given off at every stage of the process and carry the released energy into the surrounding gas.

Every stage of this series of atomic events has now been studied in the laboratory, and it is possible to calculate at what rate the cycle would occur in the gas inside the sun for a given temperature, pressure and composition. Assuming 35 per cent. of hydrogen and 1 per cent. of the heavier elements (which accords well with the intensities of lines in stellar spectra) it is found that enough heat to keep the sun going would be liberated if the temperature at its center was 19 million degrees. This is very close to the value of the central temperature which had previously been derived from the sun's observed size and mass, and the assumed hydrogen abundance.

We may therefore fairly claim that we know just why the sun shines, and can be reasonably sure that it will keep on shining for at least 10 billion years in the future (not forty, because it should grow brighter as the hydrogen gets used up). How long it has been shining in the past depends on how much hydrogen was "originally" there when it started as an independent body. If it was almost all hydrogen then, this would have been some 80 billion years ago, but this is an extreme limit.

Bethe's theory accounts not only for the sun, but for the whole great main sequence of stars, which extends from great hot white stars like those in Orion through Sirius and Procyon to the sun and to the faint red dwarf stars.

From the bright end of this sequence to the faint, we come upon stars of smaller and smaller mass, and also smaller diameter. The central temperatures may be as high as 35 million degrees at the upper end, and as low as 12 million at the bottom. The rate at which the transmutation process works increases enormously with the temperature, and the differences just described are very nearly what would be needed to provide the great radiation from the massive stars, and the feeble luminosity of the small ones.

This theory accounts for the present properties of all these stars, and enables us to predict their future; but it tells us little about their past. If, in any way, bodies of composition resembling the sun's, and of all sorts of masses, were scattered here and there through space, each one would settle down into a star. If its central temperature was at first too low to "turn on the heat" from atomic transformation, it would draw on its gravitational energy and contract till the interior became hot enough to make this work. After a few millions of years doing this, it would settle down to a steady life of billions of years, gradually consuming its hydrogen. The gravitational contraction would last longest for the least massive stars, which radiate feebly; but, after a few hundred million years, all trace of this adolescent stage would be lost.

So far, all is well; but there are still a number of acute and unsolved problems. First comes the visible existence of stars of very high luminosity. For example, Y Cygni, near the top of the main sequence, has seventeen times the sun's mass, and about 30,000 times its luminosity. It must therefore be living its life nearly 2,000 times as fast as the sun. For 29 Canis Majoris, at the very top, the mass is 46 and the luminosity is estimated by Chandrasekhar as 700,000, so that it is living more than 10,000 times as fast as the sun. The transformation of its whole mass from hydrogen to helium would supply this rate of shining for only about 10 million years, while Y Cygni might last 60 million.

Many other stars are known which are many thousands of times as luminous as the sun, and must be living their lives hundreds of times faster; and among these are red super-giants of enormous diameter like Zeta Aurigae. If these are built at all like the sun inside, their central temperatures can not be much over a million degrees. The self-regenerating carbon cycle would not work at all at these temperatures—the only hope seems to be in the interaction of deuterons (heavy hydrogen) and protons (or for somewhat higher temperatures, of lithium, etc.). These elements are very rare on earth, and in the sun. We can not prove that they might not have been more abundant in these stars. But all known nuclear reactions which involve them use them up, and, whatever assumptions we choose to make, the difficulty of the short time-scale remains. Milne's suggestion (which can not at present be disproved, though it does not look likely) that these giant stars have small dense hot nuclei in which other nuclear reactions are at work, only reduces the difficulty to the same level as for the hotter stars.

Here we are faced with a difficulty which is not yet resolved. Perhaps these stars began their existence as luminous bodies at a relatively late date in the billion years or more of history which other evidence assigns to the sidereal universe. In that case, it is hard to explain in what physical state the matter which composed them previously was, and what prevented it from starting to condense. Moreover, where are the stars which it is reasonable to suppose started earlier and have exhausted their hydrogen?

Again, it is conceivable that inside these stars the far more drastic hypothetical process of the complete transformation of mass into energy may take place—the annihilation of matter. Since nothing of the sort has been observed in the laboratory (saving the mutual annihilation of positive and negative electrons, which is beside the point) we are here in the realm of the purely speculative.

A second puzzle is raised by the existence of the white dwarfs—stars of low luminosity and enormously high density. More of these are being discovered every year, and it is evident that they form the most numerous of all classes of stars, excepting the red dwarfs, if the count is made, as it should fairly be, in a given volume of space.

Our theoretical understanding of these stars is the most satisfactory that we possess. They represent senility—the approach to the final state in which all the available energy, gravitational, nuclear, or what not, has been exhausted and radiated away into space, and nothing more can happen. Within them, the electrons are degenerate—jammed together as closely as the quantum laws permit, and further contraction is impossible.

Chandrasekhar has shown that the radius and density of a star in this state are determined by its mass (and the amount of hydrogen remaining in it). The greater the mass, the smaller and denser will be the star. For masses less than a certain limit (1.4 times the sun's mass, if no hydrogen is present) the process of contraction will end in a degenerate state. For larger masses the critical conditions will not be reached, and so far as our present knowledge goes, a star may contract indefinitely.

Now to reach the white-dwarf stage, a star like the companion of Sirius, which has nearly the same mass as the sun, must have gotten rid of all its stores of energy. If it started like the sun, it would require many billions of years to do this, while white dwarfs of smaller mass (o^2 Eridani B) which live their lives more slowly, will take still longer. When we find numbers of such stars in an expanding universe which looks as if it were only a billion or two years old, we are moved to drop into the vernacular and ask "How did they get that way?"

A bold answer was given by de Sitter. May it not be that these dense stars *came through* the period when space was last small, so that they are older than the galaxies? They would be tough nuts to crack; everything depends on how great the turmoil was at the critical time.

Finally, one more puzzle is "How did the radioactive elements get there?" These are certainly decaying, and, when bombarded in the laboratory, they break up all the more. To build them up out of lighter atoms would probably demand extreme conditions of temperature and pressure, such as can not be reached in the hotter stellar interiors.

It was supposed, a few years ago, that the liberation of energy by transmutation of hydrogen might result, as a by-product, in the formation of the heavier elements. But a careful investigation by Bethe indicates that this is extremely improbable—at least at such temperatures as exist inside the stars. So long as hydrogen and carbon are both present, this temperature can not rise much above 30 million degrees. Otherwise there would be so rapid an evolution of energy as to force a reversal of the process of gravitational contraction, expanding the star, and making its interior cooler. No way for the formation of sodium and heavier atoms appears to be open. But these elements exist in considerable abundance on the surfaces of the stars, and it is probable that they form a large part of the 64 per cent. of the sun's interior which is not hydrogen.

How they got there we do not know. It is tempting to think that just before the last expansion of the universe started, much, if not all, of its matter was under great pressure and at an exceedingly high temperature; but this is speculative.

The outcome of our discussion is this. A time-scale for the universe measured in billions of years—and in very few of them—is indicated by four independent lines of evidence. The outstanding difficulties are to explain why the giant stars still shine, and why the white dwarfs are already present.

Above all, all the witnesses proclaim with one voice that the present order of things is transitory. As Eddington puts it, "the stars are in their first innings." If things go on as they are, in less than a hundred billion years the spiral nebulae will have receded out of sight, the radioactive atoms will have run down, all but the fainter stars will be going-out—and the universe will be thoroughly uninteresting.

Of course by that time—or perhaps later—the expansion of the universe may give place to a contraction, which continues till everything—including the radiation now in remote depths—has been crowded together again in small compass; and the universe may start afresh.

Whether this may be so or not we have no knowledge; but it is surprising to me how strong an aesthetic hold this conception has on many people. (I say deliberately aesthetic and not religious, for religion has never concerned itself much about the fate of material things.)

With this wide-spread desire to believe in some cyclical restoration of activity at however great intervals, I admit frankly that I am not in sympathy. I agree with Eddington, "I am an evolutionist, not a multiplicationist. It seems so tiresome to be doing the same things over and over again." But it is in other words that I would leave the expression of this attitude with you—Rupert Brooke's:

There are waters blown by changing winds to laughter
And lit by the rich skies, all day. And after
  Frost, with a gesture, stays the waves that dance
And wandering loveliness. He leaves a white
  Unbroken glory, a gathered radiance,
A width, a shining peace, under the night.

SCIENTIFIC EVENTS

THE NEW CHEMICAL LABORATORY BUILDING OF THE UNIVERSITY OF PENNSYLVANIA

PLANS to begin construction during the bicentennial year of the University of Pennsylvania of the first of three units of the new Chemical Laboratory Building have been announced.

Dr. Paul P. Cret, professor emeritus of design, architect and alumnus, has been authorized to draw complete specifications for the first unit and plans for the two additional units to be added as funds become available. For construction and endowment of the entire building the sum of $2,000,000 is required.

The present John Harrison Laboratory of the university was established by gifts from the late Provost Charles Custis Harrison and his brothers as a memorial to their grandfather, who founded in Philadelphia, in 1792, the first permanent chemical plant in this country. The laboratory was first occupied in the fall of 1894, the department of chemistry having previously been quartered in College Hall.

In 1894 the registration of students in the department of chemistry was 57. Now there are 450 students. This number represents an increase during the past seven years of more than a hundred per cent.

Including students enrolled in other schools or departments and not majoring in chemistry, there are now more than 3,000 in the courses in chemistry and chemical engineering.

The building is one of many advances made possible by the more than 15,000 alumni and friends who have given to the Bicentennial Fund the sum of more than $4,300,000. There will be presented to the university on September 20 a Bicentennial Honor Roll containing the names of all alumni, alumnae, students, friends, firms and corporations, foundations and other organizations contributing to the fund up to that time. It will be placed with other memorabilia of the times in a sealed packet, to be preserved unopened until the year 2040, which will be the three-hundredth anniversary of the university.

THE VIRGINIA JUNIOR ACADEMY OF SCIENCE

ACCORDING to Dr. E. C. L. Miller, secretary-treasurer of the Virginia Academy of Science, there are now fifty-three organized science clubs in the secondary schools of the state of Virginia, sponsored by teachers in the various schools. Some forty-five more are in the formation period. Steps have been taken to organize these clubs into a Junior Academy of Science. At a meeting on June 5 two committees were appointed for this purpose; the members of the first committee to function as officers of the Junior Academy for the rest of this year, the second committee to function as an advisory committee from the senior academy, with final organization plans to be made at the Richmond meeting of the academy next spring.

Members of these committees are:

VIRGINIA JUNIOR ACADEMY OF SCIENCE

H. J. Davis, *chairman*, Pocahontas.
W. W. Nofsinger, *vice-chairman*, Jefferson Senior High School, Roanoke.
Miss J. Frances Allen, *secretary*, Alfred Belle Apartments, Pulaski.
J. T. Christopher, George Washington High School, Danville.
C. G. Gibbs, Floyd High School, Floyd.
Miss E. Gillespie, Maury High School, Norfolk.
Wm. T. Hall, Clarksville High School, Clarksville.

H. S. Holmes, Petersburg High School, Petersburg.
Miss Martha Lipscomb, Thomas Jefferson High School, Richmond.
W. I. Nickels, Jr., Lane High School, Charlottesville.

VIRGINIA ACADEMY OF SCIENCE SPONSORING

Professor J. A. Rorer, *chairman*, director, Extension Division, University of Virginia.
Dr. George W. Jeffers, *vice-chairman*, State Teachers College, Farmville.
L. F. Addington, Wise.
L. C. Bird, president, Phipps and Bird, Inc., Richmond.
Francis S. Chase, *executive secretary*, Virginia Education Association, Richmond.
Dr. I. A. Updike, Randolph-Macon College, Ashland.

The junior academy will meet with the senior academy at the regular annual meeting, have a program of its own and present exhibits of the work done by members of the science clubs. It is hoped also to have exhibits at the Thanksgiving meeting of the Virginia Education Association in Richmond. The senior academy plans to foster and assist these science clubs in any way it can and to encourage the development of more clubs.

Members of the junior academy will eventually become members of the senior academy, and will gradually take their places as leaders in the scientific life of the state.

SUMMER WORK IN BOTANY OF THE UNIVERSITY OF MICHIGAN

THIS year, owing to international conditions, members of the faculty of the University of Michigan, according to the *Alumni Journal,* are confining their activities largely to work in the United States. The summer camps include the Biological Station, Douglas Lake; Camp Davis, Jackson Hole, Wyo., where work is being done in surveying, geology and botany; Camp Filibert Roth, the forestry station at Golden Lake, and the camp at Wilderness Park, near Mackinaw City, where a field course in geography is being offered.

Members of the department of botany are engaged in trips to areas from Alaska to Panama. Professor Harley H. Bartlett, department chairman, and Tobias Lasser have gone to the Chagres River, Panama, for malaria investigations; Professor D. V. Baxter will make a collecting trip to Alaska. Other collectors include Professor F. M. Pagan, who will collect in Mexico; Professor C. A. Arnold, in Colorado; Professor B. M. Davis, in Oregon; Dr. J. L. Baldwin, Jr., in the mountains of West Virginia, North Carolina, South Carolina and Georgia, and Dr. E. U. Clover, in the Havasupai Canyon, Ariz. Professor W. R. Taylor will be at the Woods Hole Marine Biological Laboratory. After spending the college year at the University of Puerto Rico, where he collected mosses and liverworts, Professor W. C. Steere will devote the summer to work at the Biological Station at Douglas Lake. Professor L. E. Wehmeyer will be at Camp Davis.

Members of the Forestry and Conservation School are doing experimental work at the Chase S. Osborn Preserve at Sugar Island and at "Ringwood," near St. Charles. Professors W. F. Ramsdell, L. J. Young and others are engaged in this study. In addition, Professors E. C. O'Roke and S. A. Graham are engaged in research at and near Camp Filibert Roth; Professor D. M. Matthews is carrying on research on the relation between logging costs and forest management on the Pacific coast and in the "Inland Empire"—Idaho, Washington and Montana; Professor S. W. Allen is leading two expeditions for the American Forestry Association in the Rocky Mountain region, and Professor D. V. Baxter is conducting a study and collection of fungi in Alaska.

From the University Herbarium, Dr. E. B. Mains is studying the fungi of the Colorado mountains; Dr. and Mrs. C. L. Lundell, the flora of Texas, and Dr. A. H. Smith, Michigan fungi.

THE BROWN UNIVERSITY ECLIPSE EXPEDITION

AN attempt to prove definitely that the zodiacal light of the sun can be photographed during a total eclipse will be made by an expedition to South America headed by Professor Charles H. Smiley, chairman of the department of astronomy of Brown University, to observe the eclipse of October 1.

The expedition, which is sponsored also by "the Skyscrapers," an amateur astronomical society of Providence, R. I., will set up high-speed cameras near the village of Quixeramobim, Brazil, at the eastern shoulder of South America about 100 miles northwest of Pernambuco. At this point the total eclipse will occur at 10 A.M., and will last for nearly five minutes.

Accompanying Professor Smiley will be Mrs. Smiley and Arthur A. Hoag, of Barrington, R. I., a junior at the university. Dr. Alice Farnsworth, head of the department of astronomy at Mount Holyoke College, may join the group in South America. Good weather is anticipated, since it seldom rains or is even cloudy in Quixeramobim in October.

Although only three other astronomers have reported seeing the zodiacal light during an eclipse of the sun, Professor Smiley photographed what he describes as "similar phenomena" during the total eclipse of June 8, 1937, when he took pictures from a vantage point high up in the Peruvian Andes. These showed a double wedge-shaped light area fanning out from above and below the sun, and extending at least 25 times the diameter of the sun into space. It was contered along the ecliptic. The phenomenon was distinctly separate from the corona. Professor Smiley hopes to verify these results, and to obtain more conclusive photographs on his forthcoming expedition. He is especially interested in determining whether the zodiacal light can be seen and photographed at sea level. Other observations, including his own in Peru, have been made from altitudes of at least 14,000 feet.

Two astronomical instruments recently devised, the coronograph and the coronavisor, now permit astronomers to view the bright inner corona of the sun at any time, but an eclipse is still necessary to see the outer corona and the fainter zodiacal light.

The expedition plans to leave Providence about August 15. With the European war eliminating many steamer routes, it will probably take a boat for Rio de Janeiro, and then retrace its route *via* the coast of Brazil, either by land, air or water, to Quixeramobim.

CORRESPONDENT

THE DETROIT MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE American Chemical Society will meet in Detroit from September 9 to 13. All divisions will be represented on the program. According to the announcement of the society nineteen symposia have been planned.

The Division of Agricultural and Food Chemistry is sponsoring a symposium on Fruits and Fruit Products and another on Animal Nutrition, the latter emphasizing phases other than vitamin chemistry. It is joining with the Division of Fertilizer Chemistry in celebrating the one hundredth anniversary of Liebig's paper on Agricultural Chemistry. The papers to be given will evaluate the significance of Liebig's contributions in the light of modern agricultural chemical concepts. The Division of Biological Chemistry has organised a program on vitamins and nutrition in which the Division of Agricultural and Food Chemistry will cooperate. Two sessions will be held for presentation of papers on miscellaneous subjects within the field of the division.

The Division of Biological Chemistry is planning symposia on phases of the protein problem; tentatively, titles selected are *Aspects of Intermediary Protein Metabolism* and *Aspects of Sulfur and Protein Metabolism*. The usual program on vitamins and nutrition will be held jointly with the Divisions of Agricultural and Food Chemistry and Medicinal Chemistry.

The Division of Cellulose Chemistry will meet for three general sessions.

The Division of Chemical Education in two symposia will discuss the first two years of college chemistry and chemistry in the high school.

The Division of Colloid Chemistry will present a program of diversified papers.

The Division of Fertiliser Chemistry will sponsor a symposium on Liebig in which his contributions to agricultural and fertilizer chemistry will be discussed. This program commemorates the one hundredth anniversary of Liebig's epoch-making address before the British Association for the Advancement of Science. The Division of Agricultural and Food Chemistry will join in this celebration. A program of general papers will be offered.

The Division of Gas and Fuel Chemistry has arranged two sessions of miscellaneous papers and a symposium on Atmosphere Conditioning for Metallurgical and Chemical Processes.

The Division of the History of Chemistry will offer a short program of miscellaneous papers.

The Division of Industrial and Engineering Chemistry has organized three symposia: Glass—What Is Old? What Is New? under the chairmanship of Alexander Silverman; New Textile Fibers, Fabrics, and Finishes under the leadership of Gustavus J. Esselen, and Unit Processes under the direction of R. Norris Shreve.

The Division of Medicinal Chemistry will cooperate with the Divisions of Agricultural and Food Chemistry and Biological Chemistry in a program on vitamins and nutrition. It also is sponsoring a symposium on Methods for the Standardization of Drugs and a program of general papers.

The Division of Microchemistry will meet for two sessions of miscellaneous papers.

The Division of Organic Chemistry will hold six sessions for the reading and discussion of papers.

The Division of Paint and Varnish Chemistry is arranging one session for papers on resins and plastics, two on paint and varnish and another symposium on Automotive Finishing.

The Division of Petroleum Chemistry is featuring an extensive symposium on Petroleum Chemistry's Contribution to the Automotive Field. This will not only include the better known uses for power and lubrication, but will consider uses of petroleum products in coatings, plastics, shock absorbers, etc.

The program of the Division of Physical and Inorganic Chemistry includes three symposia: The Transfer of Energy in Molecular Collision; Chemical Equilibrium at High Pressures and Elevated Temperatures, and Fluorine Chemistry. Sessions will be available for papers on physical, inorganic and analytical chemistry. The division will meet, as usual, for dinner.

The Division of Rubber Chemistry is sponsoring a symposium on Rubber in the Automotive Industry to be held on Thursday. Ample opportunity will be provided on the following day for the presentation of other papers on rubber chemistry. The division will hold its banquet on Thursday evening in the Book-Cadillac Hotel. W. J. Cameron, of the Ford Motor Company, will be the speaker.

The Division of Sugar Chemistry and Technology will have a program of miscellaneous papers in two sessions.

The Division of Water, Sewage and Sanitation Chemistry plans three general sessions. On Thursday the members will visit the Springwells Filtration Plant, the Detroit Sewage Plant and the Dearborn Sewage Plant. Lunch will be served at the Dearborn Inn, followed by a short visit to Greenfield Village.

SCIENTIFIC NOTES AND NEWS

THE National Academy of Sciences will meet on October 28, 29 and 30 at Philadelphia following the bicentennial celebration of the University of Pennsylvania. Sessions will be held in the Zoological Laboratory. On Monday evening there will be a public lecture in the University Museum, following a dinner given by the university for the members of the academy. On Tuesday evening there will be a reception by President and Mrs. Jewett and a subscription dinner at the Bellevue-Stratford Hotel.

PROFESSOR RAYMOND PEARL, of the Johns Hopkins University, has been elected an honorary member of the Royal Society of Medicine (Section of Epidemiology and State Medicine).

AT the convocation of the University of Chicago on June 11 the honorary degree of doctor of science was conferred on Dr. Ludvig Hektoen. The citation reads: "In recognition of his scholarly achievements in basic science and his distinguished service to the university and to medicine as a great teacher, editor and administrator."

AT the commencement exercises of the North Carolina State College at Raleigh the honorary degree of doctor of engineering was conferred on Dr. Clement L. Garner, chief of the Division of Geodesy of the U. S. Coast and Geodetic Survey.

THE Osler Memorial Medal of the University of Oxford for 1940 has been awarded to Sir E. Farquhar Buzzard, professor of medicine in the university.

DR. ANDREY ABRAHAM POTTER, dean of the Schools of Engineering and director of the Engineering Experiment Station at Purdue University, was presented with the Lamme Medal for 1940 of the Society for the Promotion of Engineering Education at the recent meeting at the University of California. Presentation of the award was made at the annual dinner by Professor Herbert B. Langille, of the university. The citation reads: "for his leadership in the advancement of the profession of engineering; for his devotion to high standards of teaching and his contributions to the development of engineering education; for his understanding of human nature and sympathetic interest in the work of his associates and students, for his sound judgment and skill as an engineer, and for his untiring efforts in developing cooperative relations between engineering colleges and industry."

THE medal of the American Laryngological, Rhinological and Otological Society for "conspicuous public service" has been awarded to Dr. James Sonnett Greene, founder and director of the National Hospital for Speech Disorders, "for his unselfish devotion to the alleviation of speech defects in those thus afflicted, and for the success which has crowned his life-long efforts in having established the National Hospital for Speech Disorders."

THE James Alfred Ewing Medal of the British Institution of Civil Engineers, founded in 1936 in memory of the late Sir Alfred Ewing and given "for especially meritorious contributions to the science of engineering in the field of research," has been awarded for 1939 to Professor G. I. Taylor, Yarrow research professor of the Royal Society.

DR. HERBERT A. WAGNER, president of the Consolidated Gas, Electric Light and Power Company of Baltimore, has retired from the presidency of the Maryland Academy of Sciences and is succeeded by Dr. S. Karrer, who has been director of research of the company since 1926. Dr. Wagner continues to be chairman of the board of trustees.

Museum News reports that on March 26 at the annual meeting of the South African Museums Association at Capetown, E. C. van Hoepen, of the National Museum, Bloemfontein, was elected president, and E. C. Chubb was reelected secretary and treasurer. The association voted to hold the meeting in 1941 at Johannesburg.

AT the Harrison, N. Y., meeting of the American Neurological Association officers were elected as follows: Dr. H. Douglas Singer, of Chicago, president, and Dr. Gilbert Horrax and Dr. H. C. Solomon, both of Boston, vice-presidents.

AT the recent annual general meeting of the British Institute of Physics the following officers were elected to take office on October 1: *President,* Professor W. L. Bragg; *Vice-president,* Dr. B. A. Keen; *Honorary Treasurer,* Major C. E. S. Phillips; *Honorary Secretary,* Professor J. A. Crowther; *Members of the Board,* Professor E. A. Owen, Dr. C. Sykes and Professor G. I. Finch (appointed by the Physical Society), and Dr. R. W. Lunt (appointed by the Faraday Society).

PROFESSOR OTTO L. KOWALKE retired on July 1 from the chairmanship of the department of chemical engineering of the University of Wisconsin. He has been chairman of the department for twenty-seven years and a member of the teaching staff for thirty-three years. He plans to devote his time to research and teaching.

PROFESSOR A. B. DAWSON, who has been director of the Biological Laboratories of Harvard University for the past five years, has been appointed chairman of the department of biology to succeed Professor F. L. Hisaw, who recently resigned.

DR. MILTON J. ROSENAU, head of the Division of Public Health of the Medical School of the University of North Carolina, the title of which has been changed to the School of Public Health, becomes first dean of the new school.

DR. BRUNO ROSSI, formerly professor of physics at the University of Padua, research associate at the University of Chicago, has been appointed associate professor of physics at Cornell University.

DR. MEREDITH P. CRAWFORD, formerly instructor in psychology at Barnard College, has been appointed assistant professor of psychology at Vanderbilt University.

DR. HOKE S. GREENE, director of graduate studies in chemistry and chemical engineering at the University of Cincinnati, has been made associate professor of chemical engineering; Harold J. Garber, who took part in the planning and construction of the new addition to the chemistry building, has been appointed assistant professor in chemical engineering.

DR. CHARLES C. DEAM, research forester in the Division of Forestry of the Conservation Department of the State of Indiana, has retired from active service. He has prepared a flora of the state for which he collected over 59,000 plants and examined in all 84,600 specimens.

AWARDS for research to members of the faculty of Wesleyan University for 1940–41 include Associate Professor Herbert E. Arnold, for a computation of statistical tables for testing the significance of experimental results; to Assistant Professor Jack Buel, for studies in the relative importance of specific response patterns and goal orientation in learning; to Professor Walter G. Cady, for studies in piezo-electricity; to Professor Burton H. Camp for a study of problems in mathematical statistics with particular reference to the theory of testing, and to Professor Frederick Slocum, for studies in stellar parallax determinations.

THE Committee on Scientific Research of the American Medical Association has approved a grant to Dr. Oscar V. Batson, professor of anatomy in the Graduate School of Medicine of the University of Pennsylvania, for his quantitative studies of nystagmus.

THE John and Mary R. Markle Foundation of New York has made a grant of $2,000 to the School of Medicine of Western Reserve University to support an investigation of intravenous bismuth injections by Drs. Torald Sollmann and Joseph Seifter, of the department of pharmacology.

Nature states that J. Davidson Pratt, general manager of the Association of British Chemical Manufacturers, has been appointed an additional deputy director-general for chemical research, experiment and development in the British Ministry of Supply, and Sir Frank E. Smith, director of instrument production, has, in addition, been appointed controller of telecommunications equipment.

DR. HERMANN DE JONG, formerly director of the Physiological Institute of Amsterdam, is visiting the United States.

THE Geologic Division of the Tennessee Valley Authority has been moved from Knoxville to Chattanooga. Major Edwin C. Eckel, chief geologist; Berlen C. Moneymaker, assistant chief geologist, and Robert A. Laurence, geologist, and their staffs will go to Chattanooga.

A COURSE of lectures on recent advances in plant pathology is being given this summer at the Iowa State College, both by members of the faculty and by visiting lecturers. Visiting lecturers and their subjects are: Dr. William H. Stanley, associate member, the Rockefeller Institute for Medical Research, "Viruses," June 17 to 20; Dr. A. H. Reginald Buller, professor of botany at the University of Manitoba, "Fungi," June 24 to 27; Dr. George Keitt, professor of plant pathology at the University of Wisconsin, "Parasitism," July 1 and 2; Dr. C. M. Tucker, head of the department of botany at the University of Missouri, "Inheritance of Resistance to Disease," July 8 and 9; Dr. H. C. Murphy, pathologist, Bureau of Plant Industry, U. S. Department of Agriculture, "Resistance and Susceptibility in the Rusts and Smuts Parasitizing Oats," July 15. Members of the department of botany contributing to this course of lectures are: Professors I. E. Melhus, G. C. Kent and Walter Buchholtz.

THE American Society of Ichthyologists and Herpetologists will hold its twenty-third annual meeting at the Royal Ontario Museum of Zoology, Toronto, on September 2, 3 and 4. The International Association of Game, Fish and Conservation Commissioners and the American Fisheries Society will meet in Toronto during the same week, at the Royal York Hotel, the former on September 2 and 3 and the latter on September 5 and 6.

THE autumn meeting of the American Society of Mechanical Engineers will be held at Spokane, Washington, from September 3 to 6. A group of papers, of interest to mechanical, civil, electrical and mining engineers, is to be presented in sessions sponsored by the hydraulics, wood industries, heat transfer, fuels, power and management divisions of the society. The inspection trips, stressing wood industries, power developments, mineral industries and scenic wonders, are unique and of general as well as of technical interest. The program calls for technical sessions on Tuesday, September 3, and Thursday, September 5, leaving Wednesday and Friday open for inspection trips. The trip to Grand Coulee Dam on Wednesday will be preceded by a general interest talk on the dam at the banquet on Tuesday evening. Friday is being left open for trips to the lumber mill at Lewiston, the mines of northern Idaho, the Columbia River Basin Project, or the scenic lakes of the region.

THE tenth annual meeting of the American Malacological Union was held at the Academy of Natural Sciences, Philadelphia, from June 17 to 21. The program included the presentation of a testimonial of appreciation to Norman W. Lermond, curator of the Knox Academy of Arts and Sciences, Thomaston, Maine, for his preliminary work in the organization of the society; and to Dr. Henry A. Pilsbry, curator of mollusks, Philadelphia Academy of Natural Sciences, its first president. In honoring Dr. Pilsbry on this occasion, the union is issuing a complete bibliography of his published works. This publication will be available for students of Mollusca by the end of August. Officers were elected as follows: *President,* Dr. Harald A. Rehder, U. S. National Museum; *Vice-president,* Frank Collins Baker, University of Illinois; *Corresponding Secretary,* Norman W. Lermond, Knox Academy of Arts and Sciences, Thomaston; *Financial Secretary,* Mrs. Harold R. Robertson, Buffalo Museum of Science. John Oughton, Royal Ontario Museum of Zoology, Toronto, was elected *Councillor at Large* to fill the vacancy occasioned by the resignation of Aurele La Rocque, of the National Museum of Canada. The next meeting will be held in the Knox Academy of Arts and Sciences, Thomaston, from August 5 to 8, 1941.

THE second annual exhibition of photographs of wild life under the auspices of the New York State Nature Association will be held at the Albany Institute of History and Art from October 30 to November 10. A first prize of $20, a second prize of $10 and a third prize of $5 will be awarded to the pictures which best represent the spirit and beauty of living wild birds and animals photographed in their natural surroundings. The prize-winning photographs will become the property of the New York State Nature Association.

THE United States Civil Service Commission has announced an open competitive examination to fill the position of senior engineering aid (topographic) in the U. S. Geological Survey. The salary of the position is $2,000 a year, less a retirement deduction of 3½ per cent. Except for the substitution of experience, applicants must have completed high-school study; and, in addition, must have had responsible civil engineering experience, partly on topographic field surveys. Certain engineering study in a college may be substituted for part of the experience. Applicants will not be given a written test, but will be rated on their qualifications, as shown in their applications, and on corroborative evidence. Applications will be rated as received at the commission's Washington office until December 31.

The Alumni Review of the University of North Carolina states that at a meeting of the trustees on June 7 a settlement proposed by its finance committee and agreed to by the executors and beneficiaries of the Flagler estate was approved. From this fund the university since 1917 has received annually the sum of $75,000 to pay the Kenan professors. The settlement represents a generous interpretation by William R. Kenan, Jr., and his co-executor, Mr. Harris, and the chief beneficiaries of the will. The Kenan Fund was established in 1917 as a memorial to William R. Kenan, father of Mrs. Bingham, and her two uncles, Thomas S. Kenan and James Graham Kenan, all graduates of the university. The will provided that the university should be paid $75,000 annually for twenty-one years, at the end of which period it should be paid an amount sufficient "at the rate of interest then current in North Carolina" to earn $75,000 annually thereafter. Legal advisers to the executors suggested for transfer to the university securities valued at $1,100,000 and yielding the amount of the annual income desired. Mr. Kenan, his co-executor, and Mrs. Graham Kenan and Mrs. Jessie Kenan Wise recognized, however, that funds reinvested in long-term securities by the university might not earn so high a yield. Accordingly, they agreed to a settlement of $1,875,000 which in effect represented an additional gift by the estate, of which they are the chief beneficiaries, of $775,000. The university in appreciation of their action added to the settlement sum an accumulated Kenan Fund reserve of $182,000 together with $43,000 from a pre-consolidation escheats fund to make the endowment of the Kenan Fund $2,100,000.

DISCUSSION

THE NON-SPECIFICITY OF AMINO ACID CONFIGURATION IN MALIGNANT TISSUE HYDROLYSATES

THE development and application of the Krebs *d*-amino acid oxidase to the determination of total *d*-amino acid, described by us in these columns earlier this year,[1] provided a unique opportunity to subject to test both the broad claims and the expectations of Kögl and coworkers[2] in regard to cancer being characterized by proteins containing amino acids of partially unnatural (*d*-) configuration.[3] The uniformly low, randomly distributed values of 1 to 3 per cent. *d*-N of total-N found by us in the hydrolysates of a wide variety of appropriate and representative normal and tumor materials definitely eliminated the main claim of malignancy specificity with respect to total *d*-amino acid. The data obtained excluded a statistically significant difference between the malignant and normal tissue hydrolysate groups studied of greater than 0.5 per cent. in the observed average values of about 1.7 per cent. *d*-N of total-N in each group. Further search might, of course, reveal exceptional values in either group, but scarcely with appreciable bearing upon the generality of the conclusion reached.

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[1] F. Lipmann, O. K. Behrens, E. A. Kabat and D. Burk, SCIENCE, 91: 21, 1940.

In a recent note in SCIENCE Arnow and Opsahl[4] raise the point that *d*-glutamic acid, even if not total *d*-amino acid, might still be specifically characteristic of malignancy, providing the *d*-glutamic acid were of the same order of magnitude as the amino acids known to be racemized chemically during hydrolysis, and hence experimentally difficult to distinguish therefrom by the oxidase method. This suggestion, however, obviously introduces a *double* claim of malignancy specificity. For to assume that the malignant hydrolysate material contained some half of its *d*-amino acid-N specifically as *d*-glutamic acid-N—or much more than half as the literal 1.6 per cent. value proposed by Arnow and Opsahl would suggest—logically introduces the further implicit claim of a corresponding *deficiency* in the malignant material of half or more of that *d*-amino acid-N found in the normal material. Such a claim would, to say the least, be very difficult to maintain.

In regard to the experimental data of Arnow *et al.* presented in three other notes[5] held by them to be confirmatory of malignancy specificity, it may be pointed out that the purity of the glutamic acid hydrochloride samples claimed to have been isolated from tumor or normal tissue was not independently established by indispensable N or C and H (or ash) analyses, but only by melting point. The latter criterion, however, is of essentially no significance here, for we have observed that the melting point of *l*-glutamic acid hydrochloride is unaffected (± 2° C) by NaCl impurity up to at least 50 per cent. With the Kögl procedure employed, we have frequently isolated materials of low rotation that proved upon analysis by the oxidase method to contain no *d*-glutamic acid, or far less than that indicated by the rotation; inorganic chloride and even small amounts of other occluded amino acids could be found which were difficult to eliminate upon one or two recrystallizations if these were carried out, as recommended by Kögl, with a weight loss of less than 10 per cent. It is obviously impossible, in the absence of adequate analytical control, to deduce the presence of *d*-glutamic acid merely from rotation values low for *l*-glutamic acid. The yields of materials isolated by Arnow *et al.*, where reported at all, were very scanty, and hence almost certainly stereochemically unrepresentative;[6] they were but one tenth to one hundredth the quantities of glutamic acid found in tissues upon complete isolation by the Foreman-type procedure,[6] by ourselves employing a considerably improved Kögl procedure involving vigorous stirring during crystallization or by isotopic analysis.[7] It is difficult to see that the data of Arnow *et al.*[5] have much if any bearing on the question of malignancy specificity at hand.

As to the possibility that *d*-glutamic acid occurs specifically in malignant material as a *small* fraction of the total *d*-amino acid, there is now developing abundant evidence that, providing appropriate methods of isolation or analysis are employed, *d*-glutamic acid is to be found in hydrolysates of both normal and tumor material, and to about the same small extent in each. As indicated in our earlier communication on the oxidase method,[1] no attempt was made to determine individual *d*-amino acids, in particular *d*-glutamic acid, in hydrolysates, except *d*-amino acids intentionally added as controls, but reference was made to forthcoming determinations based upon isotopic analysis with deuterium, a second method of *d-amino* acid analysis not involving the incomplete or unrepresentative isolation procedures employed by Kögl or Arnow. Details must still await full publication, but we may briefly report here that the samples B and D of human normal liver and liver carcinoma earlier found[1] to contain 2.4 and 1.7 per cent. total *d*-amino acid-N of total-N both showed upon analysis with deuterium the definite presence of small, approximately equal quantities of *d*-glutamic acid of the order of several tenths of a per cent. of the original dry weight of tissue. These results agree very well in order of magnitude with the bulk of values reported by others for normal or malignant tissues by various methods, and in particular by Chibnall *et al.*[6] for fairly complete isolation,[8] by Graff, Rittenberg and Foster[7] from isotopic nitrogen analyses, and from expectation based upon glutamic acid racemization[9] now to be reported.

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[2] F. Kögl and H. Erxleben, *Zeits. physiol. Chem.*, (*a*) 258: 57, 1939; (*b*) (with A. M. Akkerman) 261: 141, 1939; (*c*) 261: 154, 1939; (*d*) (with H. Herken) 263: 107, 1939; (*e*) 264: 108, 1940.

[3] In any consideration of the Kögl claim it is important to bear in mind that this claim was made with respect to a variety of amino acids, including not only glutamic acid, the most prominent and easiest amino acid to isolate in this connection, but also at least leucine, lysine, valine, hydroxyproline, hydroxyglutamic acid and arginine, and even possibly to some extent those amino acids known to be racemized in part by the acid hydrolysis employed but provisionally excluded by Kögl from closer quantitative analysis because of the experimental finesse required. In his early papers Kögl laid frequent emphasis on the presence in malignant tumors of what he called "partially racemic protein," of "a derangement of stereochemical specificity possibly propagated from glutamic acid to other amino acids," or "*d*-forms of still other amino acids (even indispensable ones) that might be found in residual mother liquors." In the opening sentence of a recent paper[2d] Kögl has continued to stress his broad claim, adding a note of reproof, however, for the exclusive attention being paid by others to glutamic acid: "The discovery of partially racemic amino acids in tumor protein has quite understandably induced various workers to check our findings, but with restriction, above all, to the extreme case of glutamic acid."

[4] L. E. Arnow and J. C. Opsahl, SCIENCE, 91: 431, 1940.

[5] L. E. Arnow and J. C. Opsahl, (*a*) SCIENCE, 90: 257, 1939; (*b*) (with C. J. Watson), *Proc. Soc. Exp. Biol. Med.*, 43: 766, 1940; (*c*) (with W. G. Clark) *Proc. Soc. Exp. Biol. Med.*, 43: 767, 1940.

[6] A. C. Chibnall, M. W. Rees, E. F. Williams and E. Boyland, (*a*) *Nature*, 145: 311, 1940; (*b*) *Biochem. Jour.*, 34: 285, 1940.

[7] S. Graff, D. Rittenberg and G. L. Foster, *Jour. Biol. Chem.*, 133: 745, 1940.

Probably the most direct, simple and conclusive evidence against *d*-glutamic acid malignancy specificity is the fact now definitely established that—contrary to earlier indications (2a, p. 73; 6, p. 294)—*l*-glutamic acid itself is racemized in hot hydrochloric acid. The rates under varying usual conditions are small but readily measurable. They are of an order needed to account for essentially all the isolated or analyzed quantities of *d*-glutamic acid reported in hydrolysates of protein, normal or tumor tissue by Kögl *et al.*,[2a-d] others since,[5, 6, 7, 10] and ourselves above. In our experiments *l*-glutamic acid, when refluxed under the same conditions as employed in our earlier protein and tissue hydrolyses,[1] was converted to *d,l*-glutamic acid at an average, nearly constant rate of 0.3 per cent. per hour up to at least 50 per cent racemization. The formation of *d*-glutamic acid, measured by the decreasing specific rotation of samples removed from time to time, was further confirmed and completely established by both *d*-amino acid oxidase analysis and isolation of analytically pure partially racemic glutamic acid hydrochloride in good yield. Kögl *et al.*[2a-d] have reported 29 isolations of glutamic acid from human, rabbit and rat tumors, with an average yield of 0.4 per cent. *d*-glutamic acid of tissue dry weight. This, assuming an average of about 10 per cent. total glutamic acid in tissue dry weights,[6, 7] is an average of about 4 per cent. racemization, or of the same rough order that might be expected from simple racemization of *l*-glutamic acid during hydrolysis. Any close comparison here would obviously call for a detailed consideration of actual concentrations of reactants during hydrolysis, isolation yields, the effect, if any, of combination of glutamic acid in protein linkages, etc. Two of Kögl's tumors yielded no glutamic acid, whereas only four gave more than 1 per cent. *d*-glutamic acid of dry weight, two of these attaining 3.7 and 4.2 per cent. These latter two values, obtained by Kögl early in his work, can well be regarded, even in the light of Kögl's own work, as definitely not typical or characteristic of tumors. It would seem unprofitable or futile, therefore, to make much point concerning them, as do Arnow and Opsahl in their last note[9] on the subject at hand, in an attempt to maintain malignancy specificity on the basis of these two atypical cases, now that virtually all other cases, to the number of several score, can be readily understood on a basis of simple glutamic acid racemization during hydrolysis.

CONCLUSION

The view of malignancy specificity proposed by Kögl and supported by Arnow *et al.*, that cancers but not normal tissues or proteins are composed of partly unnatural (*d*-)amino acids, is clearly no longer tenable, both as regards *d*-glutamic acid as well as total *d*-amino acid.[11]

We again take pleasure in expressing our appreciation and indebtedness to Professor Vincent du Vigneaud for his continued counsel during these investigations.

OTTO K. BEHRENS
FRITZ LIPMANN
MILDRED COHN
DEAN BURK
DEPARTMENT OF BIOCHEMISTRY, CORNELL
UNIVERSITY MEDICAL COLLEGE, NEW YORK
CITY; AND NATIONAL CANCER INSTITUTE,
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[8] Concerning the unsuccessful isolations of *d*-glutamic acid from normal tissues by Kögl, Arnow and others, or from tumors by still others, further reference may be made to the detailed discussion and explanation by Chibnall *et al.*[6]

[9] L. E. Arnow and J. C. Opsahl, *Jour. Biol. Chem.*, 133: 765, 1940; J. M. Johnson, *Jour. Biol. Chem.*, 134: 459, 1940.

[10] (*a*) J. White and F. R. White, *Jour. Biol. Chem.*, 130: 435, 1939; (*b*) C. Dittmar, *Zeits. f. Krebsforsch.*, 49: 441, 1939; J. M. Johnson, *Jour. Biol. Chem.*, 132: 781, 1940; H. Ottawa, *Zeits. f. Krebsforsch.*, 49: 677, 1939.

[11] Added to galley proof: In an article just come to hand by F. Kögl, H. Herken and H. Erxleben (*Zeits. physiol. Chem.*, 264: 220, 1940), the applicability of the *d*-amino acid oxidase method employed by us in our earlier communication (footnote 1) is questioned in several respects. In our full publication, now in preparation, we are presenting a complete description of the method and of the data obtained, which will demonstrate in detail the validity of the earlier results and conclusions reached by us.

DIOXYMALEIC ACID OXIDASE

WE have been much interested in the dioxymaleic acid oxidase of Banga and Szent-Györgyi[1, 2] and in the evidence of Theorell and Swedin[3,4] which indicates that this new enzyme is really identical with peroxidase. We find that in the presence of fresh alcoholic dioxymaleic acid, acetate buffer of pH 4.5, partially purified horse-radish peroxidase and hydrogen peroxide, methyl red/o-carboxy-benzene-azodimethylaniline/ is rapidly oxidized and decolorized. In the absence of dioxymaleic acid the oxidation is slow. Moreover, peroxide need not be added, provided that the solution of dioxymaleic acid, methyl red, acetate buffer and peroxidase is shaken with air. In nitrogen there is no decolorization.

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[1] I. Banga and A. Szent-Györgyi, *Zeits. physiol. Chem.*, 255: 57, 1938.

[2] I. Banga, E. Philippot and A. Szent-Györgyi, *Nature*, 142: 874, 1938.

We find that peroxidase, as shown by testing with guaiacol and hydrogen peroxide, is rather rapidly inactivated by buffered dioxymaleic acid, and that this inactivation is retarded by aeration. Inactivated peroxidase is less effective in oxidizing dioxymaleic acid and in decolorizing methyl red than is active peroxidase.

Old alcoholic solutions of dioxymaleic acid give different results from fresh solutions. Here, a mixture of dioxymaleic acid, acetate buffer and peroxidase decolorizes methyl red even in nitrogen, while aeration largely prevents decolorization.

Our explanation of the rapid bleaching of methyl red in the presence of fresh dioxymaleic acid, peroxidase and hydrogen peroxide is that the peroxidase and peroxide convert the dioxymaleic acid into diketosuccinic acid and that the methyl red is oxidized by a coupled reaction. If one shakes dioxymaleic acid solutions in air, it is not necessary to add peroxide, since dioxymaleic acid is spontaneously oxidized and forms peroxide. This is in agreement with the evidence of Theorell and Swedin. Old solutions of dioxymaleic acid already contain peroxide, so that they require no shaking with air. We are not able to tell why shaking with air should retard the decolorization of methyl red in the presence of old dioxymaleic acid.

JAMES B. SUMNER
ALEXANDER L. DOUNCE

CORNELL UNIVERSITY

THE EFFECT OF GROWTH SUBSTANCES ON THE ROOTING OF BLUEBERRY CUTTINGS

THREE experiments have been conducted to study the effect of growth substance on the rooting of summer cuttings of blueberries, *V. corymbosum.* These experiments were carried on in 1937 and 1938, using in all over 2,500 cuttings from eleven different varieties of blueberries. Indole-3-acetic acid and indole-3-proprionic acid were each used dry and in solutions of 5 and 10 mg per liter. Phenyl acetic acid was used only in solutions of 10, 25 and 50 mg per liter. Auxilin was used at the recommended concentration No. 3. Phenyl acetic acid was the only one of the growth substances used which significantly increased the percentage of rooting and the greatest increase was at the medium concentration, 25 mg per liter. The results obtained with auxilin were very poor at the concentration used. The results of the above experiments are in agreement with those of Stanley Johnston's investigations independently conducted at the same time and reported in *Michigan Station Quarterly Bulletin,* 21: 255–8, 1939. From the results thus far obtained it does not seem advisable to recommend the use of growth substance for the rooting of blueberrry cuttings.

F. B. CHANDLER
I. C. MASON

UNIVERSITY OF MAINE

THE IDENTITY OF THE TREE "ANNEDDA"

FROM your review of "The Englishman's Food"[1] it appears that the authors think the tree (called by the Indians "Annedda") which cured Jacques Cartier's men of scurvy when they were wintering at Stadacona in the winter of 1535–36, was *Sassafras officinale.* The sassafras does not grow anywhere in the Province of Quebec. Its only station in Canada is a relatively narrow strip in southern Ontario and there is no reason to suppose that it ever ranged farther north.

In support of the sassafras as against an evergreen, the authors state, according to the reviewer, that Cartier's notes particularly refer to the fact that the Indians had to wait for the leaves to appear in the spring. Perhaps authority is given for this statement, but no such passage occurs in Biggar's edition of "The Voyages of Jacques Cartier." Furthermore, Cartier says[2] that it was while he was walking on the ice that the Indians told him of the tree which would cure the sickness and two squaws went with him to gather some of it. Nine or ten branches were brought back, and Cartier adds: "They showed us how to grind the bark and leaves and to boil the whole in water."

The identity of the tree Annedda has been much disputed, but from considerations not necessary to discuss here, it seems likely that it was the hemlock, *Tsuga canadensis.*

CHARLES MACNAMARA

ARNPRIOR, ONTARIO, CANADA

THE KIT FOX

IN the summer of 1911, T. A. Rocklund and I were camped for one month on the Pennell Ranch in Wallace County, Kansas, adjoining the George A. Allman

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[3] H. Theorell and B. Swedin, *Naturwissenschaften,* 27: 95, 1939.

[4] B. Swedin and H. Theorell, *Nature,* 145: 71, 1940.

[1] SCIENCE, 91: 217, 1940.

[2] H. P. Biggar, "The Voyages of Jacques Cartier," p. 212–215. Ottawa: The King's Printer, 1924.

Ranch. Mr. Allman was an early settler in the West, had been a government guide, and had shipped tons of fossils to the Smithsonian Institution. He was a very observing man and spent hours recounting to me conditions of wild-life in the early West.

He told me that it was the general custom of the early cattlemen to place poison at all the undevoured buffalo carcasses to destroy the wolves. It was his observation that the little swift foxes were always the first to take the poison. He stated that the gray wolf had not been seen in Kansas since 1879.

C. D. BUNKER

MUSEUM OF MAMMALS,
UNIVERSITY OF KANSAS

SCIENTIFIC BOOKS

THE SOCIAL ORDER

Human Nature and the Social Order. By E. L. THORNDIKE. xx + 1019 pp. New York: The Macmillan Company. 1940.

THE desirability of bringing the methods and results of the natural sciences to bear on important social problems, though often emphasized, is seldom acted on by the natural scientist in any thoroughgoing way. It takes time and courage to do so. Thorndike's new book shows courage and proves that its author has devoted much time to the study of social problems. Some of them, touching on his own special fields of psychology and education, he has attacked in original investigations. The general aim of the present book is to show how what we already know of biological psychology can be applied to social problems, and how a natural-science background enables us at least to plan an attack upon these problems. Courage is needed when existing knowledge is insufficient to furnish a direct answer. The author often ventures a well-considered judgment even when admittedly unable to offer a fully scientific solution.

The book consists of two main parts, the first, presenting certain accepted findings of psychology (and of genetics) which are especially pertinent to social problems, and the second, considering these problems in some detail. The first part, running to 400 pages, will be welcomed as a systematic account of Thorndike's main contributions to psychology. It treats of the native equipment of man, of the laws of learning, of abilities and motives and their measurement, of individual differences in ability and motivation, and of a projected science of human values.

An ability is best defined in terms of results accomplished under given conditions. So defined, abilities are very specific and particularized. The ability to add 6 and 9 is not completely identical with the ability to add 8 and 7, for an individual may show full mastery of one of these sums and still be quite shaky as regards the other. Instead then of assuming a few great "faculties of the mind," Thorndike starts with these numerous specific abilities and inquires how they can legitimately be grouped. The best empirical principle is to place together abilities that are found to exist together in the same individuals, as indicated by the correlation method.

In any sort of ability there are several variables that can be measured, such as speed, quality of work, difficulty of tasks accomplished and width or extent of the ability. In arithmetic, for instance, one person is quicker than another, one is more accurate than another, one can handle examples of greater difficulty, and one can handle a greater variety of easy examples or of examples at any level of difficulty. Since these variables can be measured, ability can be measured, though not always easily or simply.

Motives, or "wants," are treated in the same general way as abilities. In neither case is it possible at present to define and distinguish most of them in terms of the cerebral and other intraorganic operations by which external results are accomplished. Wants are necessarily defined in terms of results wanted under given conditions. We have to start our science of wants by recognizing a great multiplicity of particular wants and we find it difficult to go behind this multiplicity and discover any adequate system of fundamental or inclusive wants. Relatively few concrete human desires belong strictly under the traditional needs for self-preservation and propagation of the species. Many wants have certainly been acquired by the individual in dealing with his physical and social environment. The relative strength of various wants can be estimated from the individual's use of his leisure time and from his expenditure of his money earnings (representing his working time). On the basis of information collected on these two points, the author estimates (p. 135) that

> the 16 hours of the waking day of adults in the United States are spent roughly as follows:
>
> 25 per cent. for subsistence and perpetuation.
> 2 " " to avoid or reduce sensory pain.
> 7 " " for security.
> 8 " " " the welfare of others.
> 30 " " " entertainment.
> 10 " " " companionship and affection.
> 10 " " " approval.
> 4 " " " intellectual activity.
> 2 " " " dominance over others.
> 2 " " " other wants.

But are psychological variables such as ability and the strength of a motive susceptible of true measurement? Some critics deny it, but Thorndike has consistently stood for measurability. He would insist "that any want or satisfaction which exists at all exists in some amount and is therefore measurable, how exactly and how commensurably with others, we can not tell till we have tried" (p. 152). Measurement of wants has one advantage over measurement of abilities, because a true zero can easily be determined. Indifference, the condition of neither seeking nor avoiding a certain result, is a true zero of want intensity. If one positive want can be fairly estimated to lie twice as far above zero as another want, we have a start toward measurement. With suitable precautions, the time the individual devotes to securing a satisfaction (in comparison with other satisfactions), the amount of hardship he will undergo or the amount of money he will spend to secure a satisfaction, can be used as indirect measures of the strength of a want. In principle, then, a quantitative science of motivation is possible.

In proportion as wants are known and measured, an empirical science of values, a naturalistic ethics, becomes possible. Values are relative to wants. The value of any human action depends on its consequences, so far as they satisfy or annoy human beings or other sentient beings. Thus, the value of an act or of a thing is a natural fact—not transcendental nor absolute—and this fact is, in principle, observable and measurable. Measurement is difficult, to be sure, since different wants of the individual, and the wants of all the individuals affected by an act, must be considered and properly weighted before the most correct valuation is reached. The wants of different individuals require very unequal weights in some instances. The want of a creative artist to produce has much more far-reaching consequences in the lives of men, and therefore deserves much more weight, than the want of one ordinary man for a good dinner.

The existence of large differences between men both in wants and in abilities is a fundamental fact for social psychology. The actual distribution of ability in the population and the correlation of one trait with another are among the basic facts, even without regard to the ultimate causes of these variations. The causes also are of great importance, especially when the future welfare of mankind receives the serious consideration that it deserves. The author is convinced that hereditary factors, the genes, are responsible for a large share of the variation in intelligence that we find in a community—perhaps 80 per cent. of it, the remainder of the variation being mostly attributable to differences of training. Certainly ability of a high order is impossible without a favorable combination of genes. Hence, the great importance of eugenics for conserving and increasing human resources. "Improvement of the human genes, though much slower than some enthusiasts have represented it, is the surest means of fostering the good life; it operates at the source by producing better people. It also produces indirectly better customs and institutions" (p. 453).

Improvement of the human stock by eugenic measures is bound to be slow because the genic determination of important human traits is highly complex. But the average can be raised by measures that prevent propagation of the most unfit or favor that of the most fit. There is no prospect of raising the upper limit and producing a race of supermen, but what is most essential is to insure a plentiful supply of men and women in the upper brackets of ability, character and personality, since it is on these high-class individuals that the whole population depends for all kinds of progress and even for operating our civilization at its present level. A scientific program of eugenics must avoid any narrow definition of fit and unfit, and it demands much preliminary research into the correlations of desirable traits. But even to-day it is quite feasible by sane and moderate measures to combat the visible tendency of civilization toward elimination of the most promising strains. One measure would consist in "marriage allowances and allowances for children to men of very high intelligence and achievement during the period from 21 to 30," when most of them now receive very low wages, and another measure would be the provision of 10,000 college scholarships for children of proved ability. This last measure "would probably cause a considerable number of promising babies to be born, by removing the fear of the very definite and large costs of college education" (pp. 458, 459).

The psychology of learning has been one of Thorndike's favorite research fields since the beginning of his career. His main findings are incorporated in his celebrated "law of effect" or, more recently, in his concept of the "confirming reaction." Mere repetition of an act establishes it to a slight degree, but the immediate consequences of the act to the doer of it are the most important factor in learning. If the immediate consequences are satisfying, they release a confirming reaction in the brain. The confirming reaction reinforces the act in one way or another, causing it to be continued, immediately repeated or, if this is impossible, causing it to be "stamped in," impressed on the nervous system so as to be more readily executed on a later occasion. If the immediate consequences of an act are annoying to the doer, we might expect something opposite to the confirming reaction. We do find a cessation of the act and a shifting to some other act, but we get no evidence of a direct process of "stamping out." There is no inhibitory reaction commensurate with the confirming reaction. Reward, then, is a more powerful instrument than punishment. Such is the outcome of recent experiments by Thorndike and others. Formerly, the theory of learning treated the two as on a par.

> The traditional doctrine of common sense and of all the sciences of man was that rewards and punishments were the positive and negative halves of one same scale or gradient, closely alike in potency. . . . This doctrine is false in certain important respects. . . . Except when and as it causes the person to shift to the right behavior and receive a reward therefor, the punishment has no beneficial effect comparable to the strengthening by a reward. . . . Psychology recommends that punishment be used only when and as it can be proved to be effective. . . . In the case of government, psychology emphasizes the importance of making a community attractive to the able and good rather than unpleasant for those who are incompetent and vicious. . . . The law is rightly skeptical about restrictive and punitive activities, but has not yet progressed far with alternatives. . . . Its voice is threatening and its acts are punitive. . . . Business, in contrast to government, has operated largely by rewards. . . . In general, the maxim ''Reward good behavior'' is as nearly a golden rule as any that psychology has to offer human society (pp. 199–207).

Labor is often conceived as pure punishment or annoyance, its only rewards lying in the pay envelope. Such a view overlooks the genuine rewards that spring directly from bodily and mental activity, from achievement and mastery, from companionship and participation, from the approval of one's fellows and even from loyal submission to the right sort of boss. Management, then, should take account of the whole man and not simply of the abstract "economic man," and it should see the man in his total life situation rather than simply while on the job.

Many other problems of industry, government and human welfare are approached in the author's characteristically candid and freethinking spirit, and the net effect is to leave the reader with a hope of ultimate solution. Perhaps the main contention of the whole book is that science is the best guide for human life. "The acceptance of impartial scientific truth as the guide in life is certainly a safe and sane policy, and can be a very idealistic one" (p. 390). "The social sciences are still weak and insecure; the doctors often disagree. Some can be found to support fantastic schemes. But it is surely better on the average to take their medicine than that of ignoramuses. The scientific method is dependable. Proposed treatments to cure political, economic, or other social ailments should be studied as far as possible by the impartial methods of science" (p. 958). Governments are constantly making experiments which would have scientific value if provision were made for tracing the consequences of any given legislative or administrative measure. "Our consideration of human nature in relation to human welfare has brought forth no panacea, and promises no miracles of any description. But it has shown that man has the possibility of almost complete control of his fate, and that if he fails it will be by the ignorance or folly of men" (p. 957). Even now we can see certain dependable guiding principles, looking toward the improving of the population and the provision of suitable education and opportunity for those who are able to render public service. Able and good men must not rest content with inferior positions in the world's councils. They must acquire power so as to make their ability and good-will count heavily in social affairs.

R. S. WOODWORTH

COLUMBIA UNIVERSITY

SOCIETIES AND MEETINGS

THE CELEBRATION OF THE OHIO ACADEMY OF SCIENCE

JUST fifty years ago, some fifty-four serious-minded, forward-looking seekers after truth (scientists) gathered in a small room of the old Central High School, in Columbus, Ohio, for the avowed purpose of forming an organization that would be "an inspiration and a stimulus to original research and investigation." And so the infant *Ohio Academy of Science* was born and during the fifty years of its existence has grown in size and usefulness, fully justifying, we believe, the prophecy made by Professor William R. Lazenby, the first secretary, namely, that "Once organized, I am sure the Ohio Academy would be a signal and all-inspiring success, and could scarcely fail to secure an honored position among the scientific organizations of our country." In fact, the academy had attained such influence and importance that four years ago, in anticipation of the approaching fiftieth anniversary, and at the suggestion of Dr. F. C. Waite, of Western Reserve University, it resolved: "That the incoming President appoint a preliminary committee of five on plans for the celebration and that this committee be charged to make a definite report on plans at the meeting next year."

Accordingly, a committee of which the writer was made chairman was appointed and did make a report at the annual meeting in 1937, the report heartily approving the idea of a celebration and suggesting that "it be done in a distinctive and comprehensive manner that will not only commemorate what has been accomplished in the past fifty years, but will also stimulate yet greater endeavor in the future."

The plan was unanimously approved and action taken at once to carry it out. It was enthusiastically agreed that our late honored and highly esteemed co-worker, Dean George F. Arps, head of the Graduate School at the Ohio State University, was the very man for director, and he was unanimously chosen and accepted. Dean Arps, in his fine, enthusiastic way, laid out a most ambitious program and was busily engaged in setting up the machinery to carry it out when the "grim reaper" took him from us. For a brief period, confusion and discouragement prevailed, but, as so often happens under such circumstances, the hero emerges and it was so in this case! We found in our presidents the leadership we so sorely needed: first, President Claude E. O'Neal, of Ohio Wesleyan University, and later President William Lloyd Evans, Ohio State University. They stepped nobly into the breach and carried on to what we feel was a triumphant success.

The celebration was set for May 9, 10 and 11, at Columbus, the birthplace of the academy. The attendance was the largest in the history of the academy, and the program was full and rich, quite a number of speakers of national not to say international fame were on the program. The program began with a general meeting on Thursday evening at which His Excellency, the Governor of Ohio, John W. Bricker, spoke, also President Bevis, of Ohio State University; but the event of the evening was the address of Dr. Harvey Fletcher, of the research staff of the Bell Telephone Company, on "Sound Patterns."

Friday morning was given over to three concurrent symposia of great interest that were discussed by eminent authorities: (1) A symposium on "Hearing," discussed by R. H. Stetson and E. A. Culler; (2) a symposium on the "Basic Factors in Conservation," discussed by Guy W. Conrey, Frank J. Wright and E. N. Transeau; (3) a symposium on "Radiation and the Cancer Problem," discussed by E. U. Condon, Isadore Lampe and Francis Carter Wood. The afternoon was given over to one general meeting with three most interesting addresses: (1) Dr. R. W. Chaney, of the University of California, discussed "Forests on a Changing Earth"; (2) Dr. John L. Rich, University of Cincinnati, spoke on "Application of Airplane Photography to Geographic Studies," and (3) Dr. Charles F. Kettering, of the General Motors Corporation, spoke on "Industry and Science."

On Friday evening occurred the annual dinner and business meeting, which, as usual, was the climax of the general meetings. Two addresses were made on this occasion, one by Dr. James P. Porter, Ohio University, on "The History of the Ohio Academy of Science," and the other, a masterly presidential address, by Dr. William Lloyd Evans on "A Present-day Examination of the Postulates of John Dalton." The annual election of officers occurred at this meeting; the results are given below.

On Saturday morning the program consisted again of three concurrent symposia and in addition a botanical program. The first symposium was on "The Nervous System" and was discussed by Dr. Herbert S. Gasser, of the Rockefeller Institute, New York, by Dr. R. W. Gerard, of the University of Chicago, and by Dr. John F. Fulton, of Yale University. The second symposium was a Chemical-Physical Program and was discussed by Dr. Edward Mack, of the Battelle Memorial Institute, Dr. M. S. Newman, Ohio State University, and Dr. H. S. Booth, Western Reserve University. The third group discussed a "Genetics-Speciation Program," the leaders in the discussion being Dr. Laurence H. Snyder, of Ohio State University, Dr. Warren P. Spencer, College of Wooster, and Dr. David C. Rife, Ohio State University. In the botanical program four papers were presented: one by Dr. A. E. Waller, of the Ohio State University on "John H. Schaffner—a Résumé"; one by Dr. J. H. Gourley, Ohio Agricultural Experiment Station on "The Changing Point of View in Horticultural Research," one by Dr. Paul B. Sears, Oberlin College, on "Post-glacial Vegetation in the Ohio-Erie Region," and the fourth by Dr. E. Lucy Braun, University of Cincinnati, on "The Differentiation of the Deciduous Forests of the Eastern United States."

So much for the formal program—excellent in every detail. The meeting, however, was characterized by at least three other notable features: (1) The number and excellence of the exhibits; these were assembled and arranged by the Exhibits Committee under the leadership of Dr. Glenn W. Blaydes, of Ohio State University. Note that at the date of the printing of the program he had collected ninety-nine centralized exhibits and arranged for forty fixed exhibits; others probably came in later. The exhibits would have done credit to the American Association for the Advancement of Science; (2) The second notable step forward was the organization of a *Junior Academy Section,* under the inspirational leadership of Dr. Otis W. Caldwell, of the American Association for the Advancement of Science, and the persistent, intelligent, skillful, enthusiastic leadership of Dr. Charles W. Jarvis, of Ohio Wesleyan University, ably assisted by Mr. Orville Linebrink, of the Columbus high schools. Do you know these juniors came from many high schools in the state, and "believe it or not," they entered some sixty-seven or more papers, exhibits, demonstrations, etc., in the contest, any one of which would have done credit to their elders. If we may, without seeming to discriminate, we would like to refer to two of these: one, the "Dissecting of a Pig Embryo" put on by four girls from the Walnut Hills High School, in Cincinnati, namely, Katherine Baude, Margie Richmond, Anne Jane Theiler and Helen Weideman, with Miss Etta Elberg as sponsor; the other was entitled "Experiments Using Dry Ice," put on by two boys from the New Philadelphia High School, George Robb and Glenn Curtis, Miss Leila E. Helmick, sponsor. Both demonstrations were put on in a masterly manner, doing great credit to the pupils, the teachers and the schools from which they came. (3) The third notable advance, while not so spectacular, is very real and is found in the change in the form of government of the academy from the general to the council form of government, as provided in the revised constitution—somewhat after the manner of the American Association for the Advancement of Science.

As a result of a rather intensive campaign under the slogan "One Thousand Members in 1940" and under the leadership of Dr. C. W. Jarvis, the membership list of the academy was increased by 127 new members at the annual meeting, and still they come, and by three restorations so that we are well on the way toward 700, to say nothing of the Juniors.

The annual election resulted in the choice of the following as the officers for the ensuing year: *President,* Stephen R. Williams, Miami University; *Secretary,* William H. Alexander, Normandie Hotel, Columbus; *Treasurer,* Edward S. Thomas, Ohio State University.

WILLIAM H. ALEXANDER,
Secretary

THE ILLINOIS STATE ACADEMY OF SCIENCE

THE Illinois State Academy of Science met for its thirty-third annual meeting at Galesburg, Illinois, May 3 and 4. The meeting was well attended and facilities provided by Knox College and by the City of Galesburg were unusually well planned. All meetings progressed nicely on schedule, adding much to the pleasure and interest. The main features of the meeting on Friday were the general session in the morning, the special sections meeting in the afternoon, the Junior Academy exhibit and judging, banquets of the Junior and Senior Academies in the evening, followed by a joint lecture for both groups after the banquets. Awards for prize-winning exhibits in the Junior Academy were made following this lecture.

At the morning session three lectures were given: Dr. E. I. Fernald, professor of botany at Rockford College, and the retiring president of the academy, spoke on "Michael S. Bebb, Illinois Botanist and Letter-Writer." The lecture was illustrated with slides. Two other lectures, "Science and Common Life," by Anton J. Carlson, of the University of Chicago, and "Looking through Great Telescopes," by Oliver J. Lee, Dearborn Observatory, completed the morning program.

Arrangements were provided by the college for a joint luncheon, special tables and rooms being available for groups that desired this. The geologists met together and the Illinois branch of the American Association of Physics Teachers also. This latter group sponsored the physics section program and appointed a committee to organize an engineering and applied science section for the next annual meeting.

Altogether some 120 papers were presented at the section meetings in the afternoon. The chairmen elected to take charge of the respective sections for the ensuing year were:

Agriculture: Mr. C. H. Oathout, Western Illinois State Teachers College.
Anthropology: Mr. Floyd Barloga, 1423 N. Glenn Oak, Peoria.
Botany: Mr. Paul Voth, Department of Botany, University of Chicago.
Chemistry: Mr. George H. Reed, Knox College.
Geography: Dr. Arthur B. Cozzens, University of Illinois.
Geology: Mr. J. Marvin Weller, State Geological Survey.
Physics: Ph. A. Constantinides, Wright Junior College.
Psychology and Education: O. Irving Jacobsen, Shurtleff College.
Zoology: Dr. W. V. Balduf, Department of Entomology, University of Illinois.

It was voted to accept the invitation of a cooperating group headed by the Museum of Science and Industry, Chicago, to hold the next annual meeting there on May 1, 2 and 3, 1941.

The evening banquet was well attended and adjourned to enjoy an exciting demonstration lecture given by Dr. J. O. Perrine, of the American Telephone and Telegraph Company, who led the discussion with Pedro the Voder. The meeting was a joint one with the Junior Academy, and both groups are indebted to Dr. Perrine and the company he represented for the lecture. After the lecture awards were presented to the winners in the competition between the science groups of the Junior Academy and the American Association for the Advancement of Science. It was an enthusiastic occasion and demonstrated quite clearly the vitality of the academy work in the state of Illinois.

On Saturday morning the Burlington Railroad took a group of over a hundred Junior and Senior Academy members on a special train through their yards and tie-treatment plant in the vicinity of Galesburg. Three other science pilgrimages to points of interest in that part of the state were planned and carried out by the anthropologists, geologists and biologists. All trips were reported successful and well attended. The academy meeting was attended by over six hundred. It is anticipated that even a larger group will be in attendance next year when the meeting will be in Chicago.

Officers for the coming year are:

President: V. O. Graham, 4028 Grace Street, Chicago.
First Vice-president: T. H. Frison, State Natural History Survey, Urbana.
Second Vice-president: C. R. Moulton, Museum of Science and Industry, Chicago.
Secretary: R. F. Paton, University of Illinois.
Treasurer: John Voss, Manual Training High School, Peoria.
Librarian: Thorne Deuel, State Museum, Springfield.
Editor: Grace Needham Oliver, State Geological Survey, Urbana.
Junior Academy Representative: Miss Audry Hill, Chester High School, Chester.

Winners of the American Association for the Advancement of Science academy grants in aid for research for 1940–41 were:

Dr. F. O. Green, Department of Chemistry, Greenville College.
Dr. C. L. Furrow, Department of Zoology, Knox College.
Dr. F. R. Cagle, Southern Illinois State Normal University.

R. F. PATON,
Secretary

SPECIAL ARTICLES

DIMINISHING RESPONSE OF THE SKIN TO FREQUENTLY REPEATED REINFECTION WITH INVASIVE BACTERIA

IN experiments concerned with the mode of action of sulfanilamide we wished to make observations on the difference in the response to the drug by a primary infection as compared to the response found once an infection had been established. In devising the experiments we felt that injecting four or five small doses of the bacteria in different parts of the skin, at intervals of a few hours, would give more information than injecting a single large dose. As a preliminary step leading to this study, rabbits were injected intradermally, following this procedure but without sulfanilamide being administered. The main purpose of this preliminary note is to describe a phenomenon which was encountered constantly in the course of these studies. Details of the experiments will be published in the *Yale Journal of Biology and Medicine.*

Two groups of bacteria were studied, (*a*) two strains of *Streptococcus hemolyticus* and two strains of *Staphylococcus aureus*, which were invasive bacteria and produced large amounts of spreading factor, and (*b*) two strains of *E. coli* and one of *S. anolium*, which were not invasive and did not produce spreading factor. Broth cultures of exactly the same age were employed for the injections in each rabbit. In general, the amount of bacterial culture administered in each injection was that which when injected for the first time into rabbits would induce lesions measuring from 10 to 20 sq cm after 24 hours. For instance, when streptococcus was employed 0.1 cc of 18-hour broth culture was usually injected; when *E. coli* was employed 0.5 cc of culture were injected.

It was found that when the invasive bacteria were injected in four or five identical doses within a period of from one to twenty-four hours, using a different part of the skin for each injection, the resulting lesions, measured twenty-four hours after injection, showed marked differences both in severity and in the area through which the infection had spread; the second lesion being smaller and less severe than the first; the third smaller than the second, and the fourth and fifth, when present, smaller and much less severe than all the lesions resulting from earlier injections. These results were not affected by the site injected. The phenomenon may distinctly manifest inself as early as one hour after the first injection. Frequently the area of the lesion resulting from the last injection was as much as fifteen times smaller than that resulting from the first; indeed, oftentimes such lesion was no more than a pimple.

This phenomenon of the diminishing skin response was completely absent in infections caused by *E. coli* and *S. anolium*. However, when larger doses of these non-invasive bacteria were given so as to induce a more severe first lesion, a slight decrease in the response to the following injections was sometimes observed; and if the same amounts of bacteria were injected together with spreading factor either from streptococcus or from testicle extracts so that very large first lesions were induced, then the phenomenon was clearly present.

Antibodies were not found in the serum by the usual serological tests, and blood counts made at different intervals showed no unusual or marked variations.

These findings led us to make identical experiments with heat-killed bacteria and with bacterial filtrates. The results were as follows:

The phenomenon was practically never present when the bacteria, either invasive or non-invasive, were killed by heat. In testing the filtrates India ink was used as an indicator of the area through which each inoculum spread. Filtrates of non-invasive organisms failed to spread at all, and the area of spread of all inocula was the same. Streptococcus filtrates, endowed with a pronounced spreading power, seemed to elicit the phenomenon in some instances, and not in a very marked degree.

In identical experiments in which dilution of rattlesnake venom, a secretion containing much spreading factor, was substituted for the streptococcus filtrate, but without using India ink, the same inconclusive results were obtained as when the bacterial filtrate was employed.

As regarding the effect of sulfanilamide on the phenomenon, it is difficult to make a conclusive statement in a preliminary note. The individual results will be analyzed separately when the work is fully reported. At present the point with which we are mainly concerned is the phenomenon which occurs with invasive bacteria without the aid of sulfanilamide.

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INDUCED FORMATION OF β-GENTIOBIOSIDES IN GLADIOLUS CORMS AND TOMATO PLANTS TREATED WITH CHEMICALS

When potato tubers (*Solanum tuberosum* L.) or *Gladiolus* corms are treated with ethylene chlorohydrin in order to break the rest period,[1] the ethylene chlorohydrin absorbed by the tissues is converted into β-2-chloroethyl-*d*-glucoside.[2] Further experiments with other plant tissues and with additional chemicals have shown that the formation of glycosides with the introduced chemicals serving as aglucons can take place quite generally among the higher plants.[3] Unpublished results with carrot roots (*Daucus carota* L. var. *sativa* D.C.) and wheat tops (*Triticum aestivum* L.) have shown that these plants also form β-2-chloroethyl-*d*-glucoside from absorbed ethylene chlorohydrin. However, when gladiolus corms are treated with *o*-chlorophenol, the glycoside formed is not β-*o*-chlorophenol-*d*-glucoside even though corms of the same variety form a β-glucoside when ethylene chlorohydrin is absorbed.[4] The acetyl derivative of this *o*-chlorophenol glycoside from gladiolus corms was prepared by acetylating the material obtained by continuous extraction with ethyl acetate of an aqueous extract of treated corms which had been precipitated with lead acetate, deleaded with hydrogen sulfide and concentrated with reduced pressure. After several recrystallizations from absolute ethanol, it melted at 207.5° to 208.5° (Corr.) and had a specific rotation $[\alpha]_D^{25°} = -49.4°$ ($CHCl_3$, Concn. 2.66 g in 100 cc). Tests with partially purified preparations of the glycoside from aqueous extracts of the corms had shown that on emulsin hydrolysis two moles of reducing sugar, calculated as glucose, are liberated for each mole of *o*-chlorophenol set free, and preliminary studies with the benzimidazole derivatives[5] indicated that both sugars comprising the disaccharide were *d*-glucose. This suggested that the glycoside might be a gentiobioside and accordingly β-*o*-chlorophenol-gentiobioside heptaacetate was synthesized.[6, 7] The melting point and specific rotation of this synthetic gentiobioside were identical with the corresponding values for the isolated acetyl glycoside. Theory for $C_{32}H_{39}O_{18}Cl$: C, 51.44; H, 5.26; Cl, 4.75. Found:[8] C, 51.45; H, 4.97; Cl, 4.60. The propionyl derivatives of both the synthetic and gladiolus glycoside were also prepared and melted at 178.5° to 179° and a mixed melting point determination showed no depression. The glycoside formed in gladiolus corms is thus shown to be β-*o*-chlorophenol-gentiobioside. The quantity of β-*o*-chlorophenol-gentiobioside formed in the treated corms averaged about 0.5 g per 100 cc of expressed juice.

When tomato (*Lycopersicon esculentum* Mill.) plants were grown in sand culture supplied with a complete nutrient solution, and 0.1 to 0.2 millimole of *o*-chlorophenol added daily for about 15 days and then sampled, the roots were found to contain about one millimole of an *o*-chlorophenol glycoside per 100 cc of expressed juice. This glycoside was also β-*o*-chlorophenol-gentiobioside, since the acetyl and propionyl derivatives had the same melting point and showed no depression in mixed melting point determinations with the corresponding synthetic gentiobiosides. A β-glycoside was also formed when tomato plants were grown in the presence of chloral hydrate. The acetyl derivative of the glycoside, melting at 184° to 185°, was obtained from both tops and roots by a procedure similar to that previously used for the preparation of β-2-chloroethyl-*d*-glucoside tetraacetate from gladiolus corms.[2] When trichloroethyl alcohol was added to the nutrient medium instead of choral hydrate, the same glycoside was formed. Synthetic heptaacetyl β-trichloroethyl-gentiobioside, prepared by the reaction between trichloroethyl alcohol and heptaacetyl-bromogentiobiose in the presence of silver carbonate, had the same melting point, and it thus appears that the tomato plant forms β-trichloroethyl-gentiobioside from both chloral and trichloroethyl alcohol. It is of interest that in the detoxication of chloral in the tomato plant, as in animals, a reduction to the corresponding alcohol takes place.

These results indicate that gentiobiose is more widely distributed in plants than was previously supposed.

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[1] F. E. Denny, *Am. Jour. Bot.*, 13: 118, 1926; *Contrib. Boyce Thompson Inst.*, 8: 473, 1937.

[2] *Contrib. Boyce Thompson Inst.*, 9: 425, 1938; 10: 139, 1939.

[3] *Am. Jour. Bot.*, 25: 15s, 1938.

[4] *Contrib. Boyce Thompson Inst.*, 11: 25, 1939.

[5] Stanford Moore and Karl Paul Link, *Jour. Biol. Chem.*, 133: 293, 1940. I am indebted to these authors for providing me with a copy of this paper prior to its publication.

[6] The β-octaacetyl gentiobiose used in this synthesis was kindly supplied by Professor William Lloyd Evans, of Ohio State University.

[7] Burckhard Helferich und Ernst Schmitz-Hillebrecht, *Ber. d. Chem. Ges.*, 66: 378, 1933.

[8] Microanalyses by H. Jeanne Thompson.

It is quite likely, of course, that treatments with these chemicals stimulate the production of gentiobiose.

Details of these experiments will be published elsewhere.

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PLANT RESEARCH, INC.

CHEMICAL EXAMINATION OF THE LIPID FRACTION OF ROYAL JELLY

HEYL[1] has reported that dilute NaOH extracts or aqueous pyridine extracts of royal jelly, when injected subcutaneously for five days into 21-day-old female rats, caused an increase in follicular activity of the ovaries. Melampy and Stanley[2] have recently failed to confirm this finding. However, it is important to note that the latter workers used *acetone-dried* royal jelly. The use of such a solvent to remove water completely would also remove sterols, phenols, acids, esters, glycerides, etc., some of which are the very types of compounds most likely to possess gonadotropic activity.

For nearly two years the chemical fractionation of royal jelly has been progressing in this laboratory and biological testing of the fractions has been commenced. In a paper at present in press, the authors describe the preliminary results of the chemical examination. Royal jelly contains an ether-soluble fraction of some complexity from which the authors have been able to isolate six substances, and there are indications of several others. Royal jelly, dried to constant weight over P_2O_5 and then powdered, when exhaustively extracted with ether in a Soxhlet apparatus, yields 10 to 15 per cent. of its weight as a cream-colored, semi-crystalline material of waxy consistency. This fraction has a characteristic flowery to spicy odor. The ether-soluble material contains about 0.1 per cent. phosphorus and 0.3 per cent. nitrogen. About 85 per cent. of this fraction can be extracted from ethereal solution by dilute sodium hydroxide. The separation of phenols and acids from this alkali-soluble material, and of wax, phospholipid, sterols and glycerides from the alkali-insoluble portion, has been accomplished. The difficulty of obtaining sufficient quantities of these individual substances delayed commencement of the biological experiments.

However, some feeding experiments performed over a year and a half ago, using the fruit fly, *Drosophila melanogaster*, revealed that the ether-soluble fraction possessed a remarkable influence on the number of eggs laid and the rate of reaching sexual maturity. These results have not been reported because we had hoped to be able to identify the compound responsible for this effect before publishing. The failure of Melampy and Stanley, using acetone-dried royal jelly, to confirm Heyl's results, appears to support our finding that the active material influencing the reproductive system is in the ether-soluble fraction. The detailed results of the Drosophila experiments will be published shortly. Our chemical and biological studies are being continued.

G. F. TOWNSEND
C. C. LUCAS

UNIVERSITY OF TORONTO

SCIENTIFIC APPARATUS AND LABORATORY METHODS

ACCURACY IN ANATOMICAL DRAWING

To encourage greater accuracy in anatomy students' drawings, this year one class was provided with 8 × 10 inch sheets of cellulose acetate (du Pont Plastacele, 1/50 inch thick) ruled in centimeter squares with black auto lacquer. The students themselves prepared 8 × 10 inch heavy bristol board sheets with India ink rulings in centimeter squares (one side), in 1½ cm squares (opposite side), in ½ cm squares (another sheet, one side), and in 2 cm squares (opposite side). Both cellulose acetate and bristol board sheets were numbered vertically and horizontally so that the coordinates of points could be read off with ease.

For drawing, the clear cellulose acetate sheet is laid over the specimen and the appropriate surface of the proper bristol board inserted under the drawing paper. To draw natural size, the surface of the bristol board ruled in centimeter squares goes under the drawing sheet, its rulings clearly showing through the page. To enlarge to 1.5 × the 1½ cm ruling is used, for 2 × the 2 cm ruling, for reductions to 0.5 × the ½ cm ruling. By quickly plotting the chief features of the structures to be drawn on their appropriate coordinates on the drawing paper, the outlines are easily obtained.

Increased facility for making accurate drawings is especially apparent in dissection of nervous or circulatory systems, where simultaneous vision of all related parts is impossible without extensive excision of other organ systems. If the tip of the snout, the sternum or other landmark be fixed upon for repeated reference, the details visible at any one time may be plotted in on the coordinates, then intervening structures moved aside, and the deeper ones exposed. Replacing the cellulose acetate sheet with reference to the chosen point allows the drawing of deeper structures to continue with no distortion. This has proven especially valuable where superficial structures are exposed days before deeper ones. The drawing begun with reference to well-chosen points can be continued after deeper portions are exposed even though the superficial structures have been destroyed or thoroughly distorted in the interim.

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[1] H. H. Heyl, SCIENCE, 89: 540, 1939.

[2] R. M. Melampy and A. J. Stanley, SCIENCE, 91: 457, 1940.

Constant reference of structures in three dimensions to the strictly two-dimensional cellulose acetate sheet makes it much easier to represent these structures than would be believed possible. The drawings show great improvement.

By this method much laboratory time is saved which has hitherto been spent with ruler, measuring these same features of the animal, and in calculating magnifications before drawing the first rough outline. It reduces erasure to a minimum since the squares which show through the drawing paper can be lifted out when not in use. The ruled cellulose acetate sheet in being constantly over the specimen as it is drawn, encourages interest in the accuracy which is so essential in a science laboratory.

LORUS J. MILNE

RANDOLPH-MACON WOMANS COLLEGE

A SIMPLE ARTERY CLIP

WHILE many manufactured artery clips or serrefines are entirely satisfactory, there are none on the market which are inexpensive. This factor becomes important especially in class use or in operations where a great number are needed. An easily made clip was therefore designed which costs only a fraction of a cent.

A glance at the accompanying diagrams will show the ease with which the clip is made. Sturdy No. 3 safety pins are procured. First, the head is pried off and the head arm is straightened, then bent over (B). The sharp end of the other arm is clipped off and flattened. Next a double bend is put in each arm as shown in (C). The arms may be sprung apart to give the jaws the desired closing power. It is also advisable to bend the head arm counter-clockwise and the sharp arm clockwise to prevent over-riding of the jaws. A quarter-inch copper washer is soldered on each arm and rubber spaghetti tubing is slipped over the jaws completing the clip.

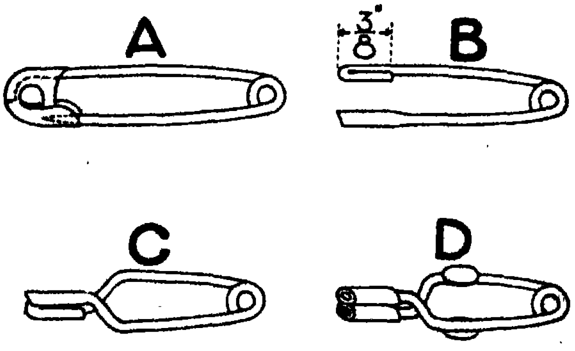

FIG. 1.

In this laboratory comparison of these clips with ready-made types has not only proved them to be as efficient, but also to be in many cases less damaging to the arterial wall.

J. R. DIPALMA

LONG ISLAND COLLEGE OF MEDICINE

ISOBUTYL METHACRYLATE AS A MOUNTING MEDIUM FOR HISTOLOGICAL PREPARATIONS

RECENTLY O'Brien and Hance[1] advocated isobutyl methacrylate as a substitute for Canada balsam in mounting histological preparations. Since these authors have stressed several advantages of this new plastic over balsam it seems advisable to point out that this substitute has proved unsatisfactory with certain histological techniques used in this laboratory.

Celloidin sections, measuring about 30 × 50 mm and 25 micra thick, through the entire hemisphere of a macaque's brain were stained with thionine for nerve cells (Nissl) or according to the Weil method for myelinated nerve fibers. Such sections mounted without a cover glass (as were the preparations of O'Brien and Hance) in xylene solutions of various concentrations of isobutyl methacrylate polymer (du Pont), warped on hardening and the surface of the medium roughened. Mounting such sections in this medium under a cover glass caused cracks and fissures in the preparations. Moreover, it was found that whereas the stain in the Nissl preparations was unaffected, the bright blue of the myelin sheaths in the Weil preparations turned to a dull gray in this medium and some of the finer detail was lost.

JOHN MEACHAM HAMILTON

YALE UNIVERSITY SCHOOL OF MEDICINE

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[1] Harold C. O'Brien and Robert T. Hance, SCIENCE, 91: 412, 1940.

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BURTON, E. F., H. GRAYSON SMITH and J. O. WILHELM. *Phenomena at the Temperature of Liquid Helium.* Pp. xi + 362. 103 figures. Reinhold. $6.00.

COHEN, JUNE B. and MILTON B. COHEN. *Your Allergy . . . and What to Do About It.* Pp. 177. Illustrated. Lippincott. $1.50.

FEIGL, F. *Specific and Special Reactions; For Use in Qualitative Analysis, with Particular Reference to Spot Test Analysis.* Translated from the German by RALPH E. OESPER. Pp. ix + 192. Nordemann. $3.50.

FIELD, HENRY. *Anthropology of Iraq. Vol. I, Part 1, No. 1, The Upper Euphrates.* Pp. 224. 61 figures. 48 plates. Field Museum.

HARING, DOUGLAS G. and MARY E. JOHNSON. *Order and Possibility in Social Life.* Pp. xii + 772. Illustrated. Richard C. Smith. $4.00.

HOGNESS, T. R. and WARREN C. JOHNSON. *Qualitative Analysis and Chemical Equilibrium.* Revised edition. Pp. xvi + 538. 83 figures. Holt. $2.90.

HUXLEY, JULIAN, Editor. *The New Systematics.* Pp. viii + 583. Oxford University Press. $6.00.

MORGAN, ALFRED. *Getting Acquainted with Radio.* Pp. x + 285. Illustrated. Appleton-Century. $2.50.

MOTT, N. F. and R. W. GURNEY. *Electronic Processes in Ionic Crystals.* Pp. ix + 275. 107 figures. Oxford University Press. $5.50.

SWINGLE, D. B. *General Bacteriology.* Pp. xii + 315. 157 figures. Van Nostrand.

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THE SEATTLE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Edited by Dr. F. R. MOULTON

PERMANENT SECRETARY

From June 17 to June 22, inclusive, the American Association for the Advancement of Science and the Pacific Division of the Association held a joint meeting in Seattle, Washington. This was the one hundred sixth meeting of the association and the twenty-fourth meeting of the Pacific Division. The Pacific Division met in Seattle in June, 1936; this was the first meeting of the association in the state of Washington.

To the residents of the eastern part of the United States, and even to those of the Middle West, Seattle seems to be very remote and not easily accessible. It is indeed distant from these regions, counting distances as they were counted only a few years ago. But ribbons of concrete, streamlined trains and airplanes have reduced distances so much that 89 members from east of the Rocky Mountains registered at the meeting. The attractions were not only a delightful climate and some of the finest scenery in the world but excellent scientific programs.

To expect anything less than a good meeting of the association in Seattle would be to ignore essential factors. Seattle is a city of nearly 400,000 inhabitants; a city which, like ancient Rome, sits on seven hills. The University of Washington has more than 12,000 students. Westerners are used to wide open spaces and are accustomed to travel, as is illustrated by the fact that although nearly 1,000 miles stretch between San Francisco and Seattle, there were 164 registrants at the meeting from California. There were Canadians from Alberta and Manitoba, as well as from nearer British Columbia, 28 of whom registered. In all there were 673 registrants, compared with 331 at the meeting held in Milwaukee, Wisconsin, in June, 1939.

At the Seattle meeting 27 affiliated and associated societies participated in the programs and a total of 644 addresses and papers were delivered or read. These addresses and papers ranged widely over the fields of the physical, biological and social sciences. Especially in the natural sciences, each of them recorded some increase in knowledge of a universe that its author was finding to be orderly and understandable. While the scientists were thinking of science there was only happiness in their hearts. But when they read the European news in the daily press a cold fog settled over them. What a commentary on "the Lords of Creation" that they find order in all the universe, both physical and biological, except in the domain of their own minds and actions! Perhaps the restlessness, ambition, greed and ruthlessness that lead from time to time to conquests are among the qualities of our race that have enabled it to rise above and dominate all other species. It is the hope and possibly the promise of science that it will be able to point out other and even more rapid ways to human progress. It can not be expected, however, that any deep-seated human characteristics will rapidly be changed. And is it not true that the ability to change implies the possibility of taking a road toward disaster as well as toward success? Can there be a capacity for happiness without there being at the same time a capacity for suffering?

Fortunately, in the Seattle region there are almost unparalleled opportunities for profitable and enjoyable excursions by scientists. Many groups under competent leaders visited the forests, the arms of the ocean or the mountains. In addition to increasing their knowledge of their own specialties, the participants in these excursions enlarged their perspectives in space and time and enjoyed the healing effects of mountains and sea and growing things.

The excursions were only one of the provisions made for the comfort, entertainment and advantage of visitors by a very competent and efficient Local Committee on Arrangements under the able chairmanship of Dr. A. F. Carpenter, executive officer of the department of mathematics of the University of Washington. The duties of the committee were largely assigned to a number of special committees: Excursions, H. A. Coombs, *chairman;* Finance, H. E. Smith, *chairman;* Meeting Places and Equipment, M. H. Hatch, *chairman;* Program, D. H. Loughridge, *chairman;* Publicity, B. H. Christian, *chairman;* Reception and Entertainment, H. P. Riley, *chairman,* and Transportation, A. V. Eastman, *chairman.* The officers of the association and all who attended the meeting in Seattle owe a debt of gratitude to these committees and to the University of Washington.

REGISTRATION

There were about 1,100 persons in attendance at the various scientific sessions, exclusive of the general sessions to which the public was invited. The total registration was 673, distributed as follows: Alaska, 1; Arizona, 6; California, 164; Colorado, 3; Connecticut, 2; District of Columbia, 7; Hawaii, 3; Idaho, 28; Illinois, 8; Indiana, 2; Iowa, 1; Louisiana, 1; Maryland, 1; Massachusetts, 3; Michigan, 1; Minnesota, 5; Missouri, 2; Montana, 16; Nebraska, 2; Nevada, 6; New Hampshire, 1; New Jersey, 3; New York, 11; North Dakota, 1; Ohio, 9; Oklahoma, 1; Oregon, 116; Pennsylvania, 5; South Dakota, 1; Tennessee, 1; Texas, 2; Utah, 7; Washington, 216; Wisconsin, 6; Canada, 28; France, 1; Peru, 1; Philippines, 1.

GENERAL SESSIONS

On Tuesday evening, June 18, Dr. Lewis M. Terman, president of the Pacific Division and distinguished head of the department of psychology of Stanford University, delivered an address on "Psychological Approaches to the Biography of Genius." Dr. Albert F. Blakeslee, president of the association, presided and introduced Dr. Terman. A large and appreciative audience listened attentively to Dr. Terman's discussion of his long-continued investigations of exceptionally talented persons.

On Wednesday afternoon, June 19, Dr. Donald Milton Erb, president of the University of Oregon, delivered an excellent address under the sponsorship of Pi Gamma Mu, a national social science honor society, on "Perspective in the Social Sciences." Dr. S. Howard Patterson, national president of Pi Gamma Mu, presided.

On Wednesday evening, June 19, Dr. Edwin P. Hubble, astronomer of the Mt. Wilson Observatory, delivered the ninth Hector Maiben Lecture, an illustrated address on "Problems in Nebular Research." Dr. Albert F. Blakeslee, president of the association, presided and introduced Dr. Hubble, who discussed his investigation of exterior galaxies and the apparently adverse evidence he has secured on the theory of an expanding universe.

On Thursday evening, June 20, Mr. S. E. Hutton, of the Bureau of Reclamation, U. S. Department of the Interior, delivered an illustrated address on "The Columbia Basin Reclamation Project and the Construction of the Grand Coulee Dam." Dr. Albert F. Blakeslee, presided.

SYMPOSIA

Fourteen principal symposia were presented at the meeting, ranging in subject-matter from cosmic rays to virus diseases of fruit trees. They were as follows:

1. *Cosmic Rays*, organized by American Physical Society. Scheduled participants in the symposium were Hans A. Bethe, Arthur H. Compton and Robert A. Millikan.

2. *Sources of Stellar Energy*, organized jointly by American Physical Society and Astronomical Society of the Pacific; papers by G. M. Volkoff and Dean B. McLaughlin.

3. *Nuclear Moments*, organized by American Physical Society; papers by N. F. Ramsey and J. R. Zacharias.

4. *The Present Crisis in the Quantum Theory of Fields*, an informal symposium organized by American Physical Society. Discussion was led by J. R. Oppenheimer.

5. *The Photoelectric Cell in Astrophysical Research*, organized by the Astronomical Society of the Pacific; 5 papers.

6. *Alaska—its Resources and its Problems*, organized by Section on Geology and Geography and Geological Society of America. The symposium consisted of two sessions at which 11 papers were read.

7. *The Species Problem*, presented under the joint auspices of the Section on Zoological Sciences, the Section on Botanical Sciences and the Western Society of Naturalists. The symposium was presented in two sessions, Robert C. Miller presiding, at each of which four papers were read.

8. *Salmon Problems on the Pacific Coast of North America*, organized by American Society of Ichthyologists and Herpetologists, Western Division. The symposium was presented at two sessions, W. M. Chapman, presiding, at each of which four papers were read.

9. *Aquatic Botany*, organized by Section on Botanical Sciences, Botanical Society of America, Pacific Division, and American Society of Plant Physiologists, Western Section. The symposium, at which George B. Rigg presided, consisted of six papers.

10. *Recent Investigations of the Characteristics of the Photosynthetic Process*, organized by Section on Botanical Sciences, Botanical Society of America and American Society of Plant Physiologists. The symposium was presented in two sessions, H. A. Spoehr presiding, at the first of which four papers were read and at the second of which three papers were read.

11. *Social and Economic Problems of the Pacific Northwest in Relation to their National Setting.* This symposium, organized by the Section on Social and Economic Sciences, consisted of 5 sessions as follows: (a) Population Trends with special Reference to the Pacific Northwest (J. F. Steiner, chairman; 5 papers); (b) Migration and Settlements: Patterns and Trends (John B. Appleton, chairman; 7 papers); (c) The Economy of the Pacific Northwest in its National Setting (Donald Milton Erb, chairman; 6 papers); (d) Standards of Living and Employment: Problems of Community Insecurity (W. F. Ogburn, chairman; 5 papers); and (e) Employer-Employee Problems and Relations (Wayne L. Morse, chairman; 7 papers).

12. *Forest Influences and Land Use Problems*, organized by Ecological Society of America and Society of American Foresters. The presiding officers were C. S. Cowan and John H. Hanley; 4 papers.

13. *Virus Diseases of Fruit Trees*, organized by American Phytopathological Society. Symposium consisted of two sessions, 6 papers read at the first and 5 at the second.

14. *Phosphate Nutrition and Phosphate Fertilization*, organized by Western Society of Soil Science and American Society of Plant Physiologists, Western Section. H. D. Chapman, chairman; 4 papers.

SCIENTIFIC SESSIONS

AMERICAN MATHEMATICAL SOCIETY

(*From report by T. M. Putnam*)

The feature of the program of the society was a joint session with the American Physical Society, at which John von Neumann presented a paper "On Operator Rings and Dimensions." There were two other sessions, at which 15 papers were presented before an audience of 52 persons. The society held a joint dinner with the Section on Mathematics.

AMERICAN PHYSICAL SOCIETY

(*From report by Paul Kirkpatrick*)

The society organized 2 symposia, participated with the Astronomical Society of the Pacific in a third symposium and held a joint session with the American Association of Physics Teachers for a program on "Training of Physicists at the Graduate Level." The program consisted of 60 papers, and 225 different persons attended one or more sessions. The society held a luncheon at which Karl K. Darrow and Frederick Bedell spoke.

AMERICAN ASSOCIATION OF PHYSICS TEACHERS

(*From report by A. A. Knowlton*)

In addition to the joint session with the American Physical Society, the society held three sessions at which 4 invited and 17 contributed papers were presented. An interesting feature of the first session was an illustrated lecture by E. C. Watson on "The Life and Work of William Gilbert as Portrayed in Old Prints."

AMERICAN METEOROLOGICAL SOCIETY

The society held 4 sessions at which 22 papers were presented, many of them pertaining to meteorological problems of the Pacific Northwest.

AMERICAN CHEMICAL SOCIETY

The society held 4 sessions at which 32 papers were presented, 8 at each session. The meeting was a Western Intersectional Meeting of the society under the chairmanship of H. V. Tartar.

ASTRONOMICAL SOCIETY OF THE PACIFIC

(*From report by T. S. Jacobsen and N. U. Mayall*)

In addition to presenting a symposium on 'The Photoelectric Cell in Astrophysical Research" and organizing a symposium and holding a joint session with American Physical Society on "Sources of Stellar Energy," the society held 3 sessions, at which 17 papers were presented. It also held an evening session, at which R. M. Petrie, of Victoria, B. C., Canada, delivered a lecture on "Solar Kinematography" illustrated by motion pictures taken at the McMath-Hulbert Observatory. The speakers at a dinner of the society were Paul W. Merrill and Joel Stebbins.

SECTION ON GEOLOGY AND GEOGRAPHY AND GEOLOGICAL SOCIETY OF AMERICA

(*From report by Howard A. Meyerhoff*)

In addition to presenting a symposium on "Alaska—its Resources and its Problems," in two sessions at which 11 papers were read, the section and the society held 4 sessions at which 42 papers were presented and organized a 300-mile petrologic field excursion, under the leadership of G. E. Goodspeed, a 150-mile glacial field excursion, under the leadership of J. Hoover Mackin, and a 3-day Cascade-Columbia Plateau field excursion, under the leadership of Richard F. Flint, Richard E. Fuller, G. E. Goodspeed, J. Hoover Mackin and A. C. Waters. About 110 persons attended the sessions of the section.

AMERICAN GEOPHYSICAL UNION, SECTION OF HYDROLOGY

(*From report by George G. West*)

The society held 3 sessions, at which the respective chairmen were Phil E. Church, J. C. Stevens and O. W. Monson, and at which 5, 3 and 4 papers, respectively, were read. At a joint luncheon on the first day with Western Interstate Snow Survey Committee and American Meteorological Society, Ukitiro Nakaya, of Hokkaido University, Japan, exhibited a sound film on "Formation of Snow Crystals in the Mountains and in the Laboratory in Japan." At a second joint luncheon the Washington Water Power Company exhibited a motion picture on "From the Snow Field to the Home." At a joint dinner with the Western Interstate Snow Survey Committee a motion picture on Snow Surveys was shown. An interesting feature of the meeting of the society was an exhibit of instruments used in the collection of hydrologic data.

OCEANOGRAPHIC SOCIETY OF THE PACIFIC

The society held a conference on "The Distribution and Cycle of Organic Matter in the Ocean."

ASSOCIATION OF PACIFIC COAST GEOGRAPHERS

The society, in its sixth annual meeting, held 6 sessions, at which 31 papers were presented, and a dinner, at which Peveril Meigs, president of the society, delivered an address on "Exploring American Orchards" and at which a motion picture on "Wheat Farming and Conservation in the Palouse" was shown. The society joined in an excursion around Seattle Harbor.

WESTERN INTERSTATE SNOW SURVEY CONFERENCE

The society held 4 sessions, at which 23 papers were presented. The first was on "Forecasting," R. A. Work, *chairman;* the second, "Equipment," R. C. Farrow, *chairman;* the third, "Activities," O. W. Monson, *chairman,* and a fourth session for the reading of miscellaneous papers. In addition, the society held a dinner, H. P. Boardman, presiding, at which a color motion picture on "Snow Surveying in the Central Sierra" was shown by Walter Herz and at which 9 speakers participated in a discussion of "Accuracy of Forecasts in Pacific Northwest in 1938–1939."

SECTION OF ZOOLOGICAL SCIENCES

(*From report by George A. Baitsell*)

The section held two joint sessions with the Section on Botanical Sciences and Western Society of Naturalists, at which a symposium on "The Species Problem" was presented under the chairmanship of Robert C. Miller. About 100 persons were in attendance at the reading of the papers and about 125 at the Biologists' dinner.

AMERICAN SOCIETY OF ECONOMIC ENTOMOLOGISTS, PACIFIC SLOPE BRANCH

(*From report by Roy E. Campbell*)

The society held a joint session with Northwest Association of Horticulturists, Entomologists and Plant Pathologists, American Phytopathological Society and American Society for Horticultural Science, Don C. Mote, presiding, at which 11 papers were presented. It also held 3 other sessions, at which 30 papers were read. The sessions of the society were attended by about 125 persons.

AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS, WESTERN DIVISION

(*From report by Margaret Storey*)

In addition to the symposium on "Salmon Problems on the Pacific Coast of North America," presented in 2 sessions, the society held 2 sessions for the reading of general papers and conducted an excursion to commercial establishments on the Seattle waterfront and frozen fish exhibit. Fifteen papers were presented, and the attendance on the programs of the society was over 150.

PACIFIC NORTHWEST BIRD AND MAMMAL SOCIETY

(*From report by Arthur Svilha*)

The society, at its twentieth annual meeting, held 2 sessions at which 12 papers were presented and joined in an open meeting with American Society of Ichthyologists and Herpetologists.

THE SECTION OF BOTANICAL SCIENCE AND THE BOTANICAL SOCIETY OF AMERICA, PACIFIC DIVISION

(*From report by Ira L. Wiggins*)

The section and the society joined with American Society of Plant Physiologists in the symposium on "Aquatic Botany" and "Recent Investigations of the Characteristics of the Photosynthetic Process," mentioned previously under "Symposia," 3 sessions, at which 21 papers were read, a 2-day excursion to the Olympic Peninsula and a joint excursion with American Society of Plant Physiologists to Friday Harbor.

AMERICAN PHYTOPATHOLOGICAL SOCIETY, PACIFIC DIVISION

(*From report by C. E. Yarwood*)

In addition to presenting a symposium on "Virus Diseases in Fruit Trees," the society held a joint session with American Association of Economic Entomologists, American Society for Horticultural Science and Northwest Association of Horticulturists, Entomologists and Plant Physiologists, at which 5 papers were presented, and 4 sessions of its own, at which 30 papers were read.

AMERICAN SOCIETY OF PLANT PHYSIOLOGISTS, WESTERN SECTION

(*From report by J. Van Overbeek*)

The society participated with other societies in symposia on "Phosphate Nutrition and Phosphate Fertilization," "Aquatic Botany" and "Recent Investigations of the Characteristics of the Photosynthesis Process" (see "Symposia," *ante*), held a joint session, under the chairmanship of William M. Atwood, with American Society for Horticultural Science, at which 7 papers were read, two sessions under the chairmanship of A. S. Crafts, at which 6 papers were read, and conducted a trip to the Oceanographic Laboratories of the University of Washington at Friday Harbor, San Juan Islands. A total of 27 papers was presented in the programs of the society which were attended by about 100 different persons.

ECOLOGICAL SOCIETY OF AMERICA

(*From report by H. de Forest*)

In addition to joining with Society of American Foresters in the symposium, "Forest Influences and Land Use Problems," the society held two sessions, one under the chairmanship of H. de Forest and the other under the chairmanship of Frederick A. Davidson, at which 10 papers were read.

WESTERN SOCIETY OF NATURALISTS

The society participated in the symposium on "The Species Problem."

SECTION ON ANTHROPOLOGY

(*From report by Erna Gunther*)

The section held two sessions, Erna Gunther and Verne F. Ray, presiding, at which 6 papers were presented. The attendance at the sessions was about 30 persons.

SECTION ON PSYCHOLOGY

(*From report by Leonard Carmichael*)

Under the excellent guidance of John E. Corbally and with the assistance of Stevenson Smith and Edwin R. Guthrie, a program was worked out for the section jointly with the Section on Education.

The first (morning) session was about equally divided between papers in psychology and education. At the joint luncheon of the sections which followed, the secretaries discussed the relationship between psychology and education and the other sciences represented in the A.A.A.S.

In the afternoon a panel discussion on the utilization of community resources for educational purposes was participated in by 6 experts in this field. The section also cooperated with the Society for Research in Child Development in 2 programs. The first of these consisted in the presentation of 5 papers in the field of the physical and mental development of young children. "The Application of Research to Practical Work with Children" was the topic of a panel discussion in the other general meeting of this society.

SOCIETY FOR RESEARCH IN CHILD DEVELOPMENT

(*From report by Stevenson Smith*)

The society held 2 sessions, one at which 5 general papers were read, and a panel discussion on "Application of Research to Practical Work with Children." Attendance, 88.

SECTION ON SOCIAL AND ECONOMIC SCIENCES

(*From report by E. P. Hutchinson*)

The section program, prepared by a local committee under the chairmanship of Kenneth O. Warner, of the Northwest Regional Council, consisted of a symposium on social and economic problems of the Pacific Northwest. The 5 sessions dealt in succession with population trends in the area, the pattern of migration and settlement, economic problems of the Northwest in relation to the national setting, the local standard of living and lastly the labor situation. Among the participants in the discussion were J. F. Steiner, John B. Appleton, Paul Landis, Richard A. Lester, Donald M. Erb and W. F. Ogburn, together with representatives of various state and federal agencies. The symposium began with a statement of the size and composition of the population of the area and the extent of the problem of dependency. From there it proceeded to a consideration of the migration trends and the prospects for future growth, surveyed the outlook for the economy of the area, considered the existing standard of living as compared to that of other sections of the country, and concluded with a discussion of employer-employee relations.

INSTITUTE OF THE AERONAUTICAL SCIENCES

The program of the society consisted of 2 sessions, under the chairmanship of Frederick Kurt Kirsten, for the presentation of papers and a dinner at which the Musick Memorial Trophy for 1940 was presented. Wolfgang B. Klemperer exhibited interesting color motion pictures of "High Altitude Flight without Power," and a color sound film on "Transpacific Flight" was shown. *During the presentation of the important* paper on "High Altitude and its Effects on the Human Body," by Drs. Randolph Lovelace, William M. Boothby and O. O. Benson, Dr. Lovelace entered a decompression chamber in which the atmospheric pressure was reduced to that at an altitude of 33,000 feet, from which he was returned to normal pressure in less than a minute.

SOCIETY OF AMERICAN BACTERIOLOGISTS, SOUTHERN CALIFORNIA BRANCH AND NORTHERN CALIFORNIA-HAWAIIAN BRANCH

(*From report by Ernest C. McCulloch*)

The society had a program of 20 papers, 17 of which were read at two sessions. The attendance was about 55. Notable papers were "A Study of Living Forms of Infectious Myxoma by High Power Microscopy," by R. E. Hoffstadt, and "Carbon Dioxide Assimilation by Propionic Bacteria Studied by the Use of Radioactive Carbon," by S. F. Carson.

SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE, PACIFIC COAST BRANCH AND SOUTHERN CALIFORNIA BRANCH

(*From report by Walton Van Winkle, Jr.*)

The society held 2 sessions at which 29 papers were presented. The attendance was about 75.

AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, WESTERN SECTION

(*From report by C. L. Vincent*)

The society held 5 sessions under the general chairmanship of E. L. Overholser, one being a joint session with Northwest Association of Horticulturists, Entomologists and Plant Pathologists, American Phytopathological Society and American Association of Economic Entomologists. At the sessions of the society 29 papers were read and the attendance was about 120.

SOCIETY OF AMERICAN FORESTERS

(*From report by G. D. Marckworth*)

The society held four sessions at which 15 papers were presented and which were attended by about 75 persons. The subject for consideration at the first session was "Forest Resources," William H. Price, *chairman*. The second session, under the chairmanship of Lyle F. Watts, was devoted to "Cutting Practices in Various Northwest Forest Types"; the third, under the chairmanship of Hugo Winkenwerder, to "Utilization Problems of the Northwest; and the fourth, with C. S. Cowan serving as chairman, to "Forest Influences and Land Use Problems." A field trip of 26 persons was taken to the Cedar River Water Shed (Seattle's Municipal Forest) and the operations of the Cascade Logging Company.

WESTERN SOCIETY OF SOIL SCIENCE

(*From report by L. T. Kardos*)

In addition to participating in the symposium on "Phosphate Nutrition and Phosphate Fertilization," the society held 3 sessions, at which 20 papers were read. Its programs were attended by a total of about 100 persons. The symposium was followed the next day by a round table discussion, under the chairmanship of R. A. Walker, of "Coordination of Research Programs in Western Phosphate Utilization."

NORTHWEST ASSOCIATION OF HORTICULTURISTS, ENTOMOLOGISTS AND PLANT PATHOLOGISTS

The society participated with entomologists, phytopathologists and horticulturists in a discussion of the use of statistical methods. A paper on "Relations of Plant Viruses to the Tissues of Hosts," by Katherine Esau, was especially important. The society held a demonstration program at the Western Washington Experiment Station at Puyallup as a part of a field trip with the Pacific Division of the American Phytopathological Society to various orchards, vegetable farms and berry fields. The total attendance was 118.

SECTION ON EDUCATION

(*From report by John E. Corbally*)

The section held two sessions with the Section of Psychology (see report of the section, *ante*). The general topic considered at the first session was "Learning Attitudes," and "The Utilization of Community Resources for Educational Purposes" at the second. About 200 persons attended the first session and 150 the second.

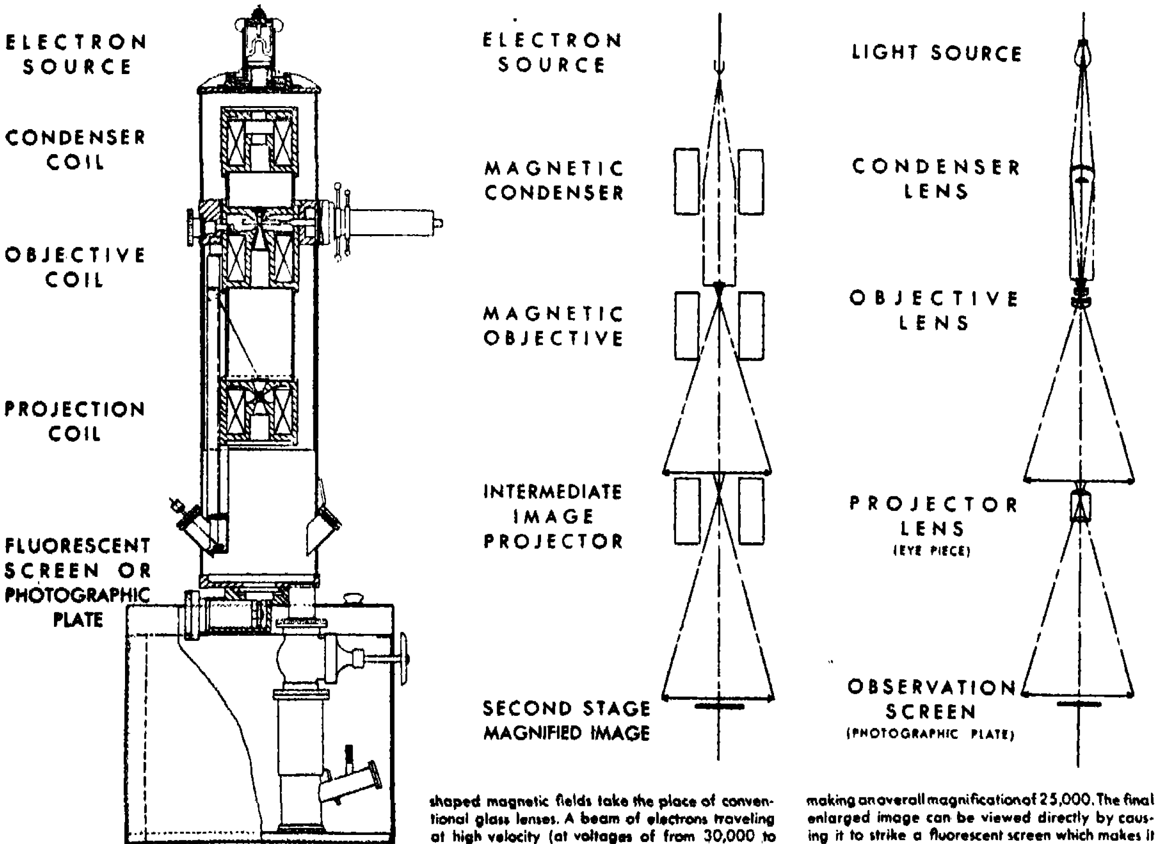
AN ELECTRON MICROSCOPE FOR THE RESEARCH LABORATORY

By Dr. V. K. ZWORYKIN

RCA MANUFACTURING COMPANY, CAMDEN, N. J.

FOR some time scientists have been aware that a considerable increase in the resolving power of microscopes could be obtained if it should prove possible to substitute for light a medium of much shorter wave-length which, like light, could be "focused"—*i.e.*, used to form images. High velocity electrons, having wave-lengths one-one hundred thousandth that of light and capable of being focused by axially symmetric magnetic and electric fields, constitute just such a medium. Certain fundamental peculiarities of these electron lens fields appear to prevent, it is true, an approach to an improvement in resolution corresponding to the ratio of the wave-lengths of these electrons and of light. Nevertheless, workers both here and abroad have demonstrated beyond doubt an increase in resolution by a factor of twenty to a hundred times.

There could be no question that an instrument having resolution capabilities one or two orders of magnitude greater than is possible with the ordinary microscope would be of incalculable value in countless researches both of a purely scientific and of an industrial nature. On the other hand, the construction and installation of an "electron microscope" introduces problems quite outside of the sphere of either the optician or the conventional microscopist. This situation caused the RCA laboratories, with their accumulated experience in electronics, electron optics and vacuum technique, to undertake the task of construct-


ELECTRON SOURCE
CONDENSER COIL
OBJECTIVE COIL
PROJECTION COIL
FLUORESCENT SCREEN OR PHOTOGRAPHIC PLATE
ELECTRON SOURCE
MAGNETIC CONDENSER
MAGNETIC OBJECTIVE
INTERMEDIATE IMAGE PROJECTOR
SECOND STAGE MAGNIFIED IMAGE
LIGHT SOURCE
CONDENSER LENS
OBJECTIVE LENS
PROJECTOR LENS (EYE PIECE)
OBSERVATION SCREEN (PHOTOGRAPHIC PLATE)

Simplified sketch of the electron microscope developed in the RCA Laboratories at Camden, New Jersey. Diagram in center shows how closely the operation of the electron microscope is analogous to the conventional light microscope. (right.) Suitably shaped magnetic fields take the place of conventional glass lenses. A beam of electrons traveling at high velocity (at voltages of from 30,000 to 100,000) takes the place of ordinary light. The electron rays are converged by condenser lens onto the specimen. After passing through the specimen, the objective lens coil forms a first image, enlarged about 100 times. The projection lens coil then magnifies the image again about 250 times, making an overall magnification of 25,000. The final enlarged image can be viewed directly by causing it to strike a fluorescent screen which makes it visible, or it can be made to record the image on a photographic plate for permanent record. The RCA electron microscope has such enormous resolving power that the final photograph can be usefully magnified by photographic enlargement up to 100,000 diameters.

FIG. 1. Simplified sectional view of the RCA Electron Microscope.

ing an electron microscope suitable for all types of research problems.

The microscope[1] was designed by L. Marton in cooperation with other staff members. Emphasis has been placed not only on attaining the highest resolution possible, but also on ease of operation, insensitivity to disturbances and safety. A simplified sectional view of the instrument is shown in Fig. 1.

At the top, some eight feet from the floor level, is the electron source, a hairpin filament of tungsten surrounded by a guard cylinder. It is the only part of the microscope at a high potential—30 to 100 kilovolts—above ground. Electrons leaving the filament are accelerated by the strong electric field between the cathode (filament and guard cylinder) and anode, pass through a hole in the latter and enter the magnetic field of the condenser lens. This, as in a light microscope, serves to concentrate the beam on the object, which, itself, is placed within the lens field of the objective, a position favorable from the point of view of minimizing the lens aberrations. The electrons which pass through the object are guided by the magnetic field of the objective so as to form an image of the object enlarged by a factor of about 100 on the fluorescent screen immediately above the projection coil. A central portion of this intermediate image corresponding to a free aperture in the middle of the fluorescent screen is enlarged once more by the projection coil, forming the final image on an interchangeable photographic plate or fluorescent screen below. This final image has a magnification of up to 25,000. Added detail may be brought out on the plates thus obtained by photographic enlargement, bringing the total magnification up to 100,000.

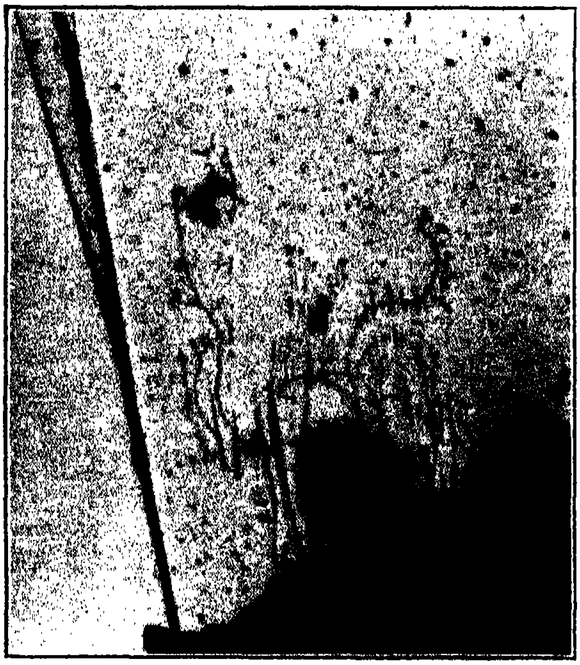


FIG. 2. Typhoid bacillus. Magnification 10,000 ×.

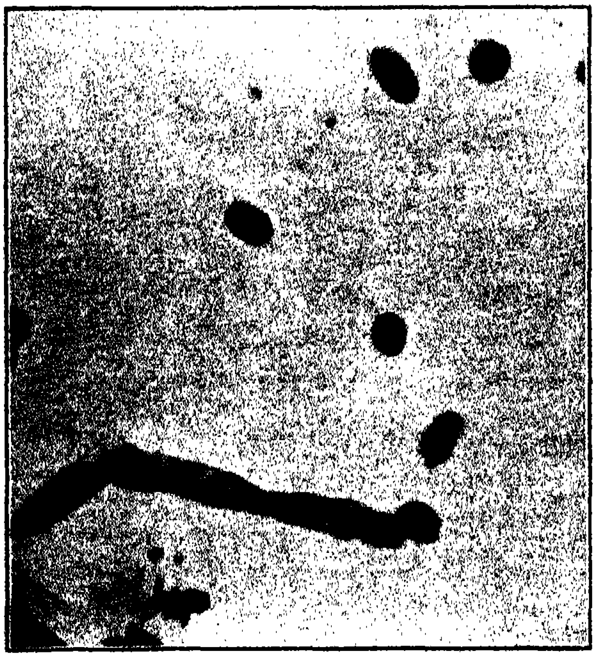


FIG. 3. Whooping cough bacteria. Magnification 9,000 ×.

The body of the microscope is made up of two large brass cylinders. This construction lends it rigidity and makes it insensitive to mechanical shock. Magnetic shielding is provided for the entire path of the electrons from the object to the final image.

The lenses consist of coils of magnet wire provided with soft iron shields so shaped as to give a desirable magnetic field distribution along the axis of the microscope. As the entire body of the microscope is evacuated, the coils are sealed into copper cans, the leads being brought out through glass-to-metal seals.

A suitable technique for the preparation of specimens and for their introduction into the evacuated microscope was first worked out by Dr. Marton. In the microscope under discussion the object is placed on a nitrocellulose film less than a millionth of an inch in thickness, which is stretched over a small disk of fine wire cloth. This disk is clamped between two apertures in a pair of blades. After the object holder has been introduced into the forechamber of an air-lock, this chamber is evacuated. Thereupon an inner gate is opened with the aid of an externally operated crank and the object is moved into position within the objective. Further screws and gears, manipulated externally, translate the object horizontally and ver-

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[1] For a more detailed description see L. Marton, "A New Electron Microscope," *Physical Review* (in press).

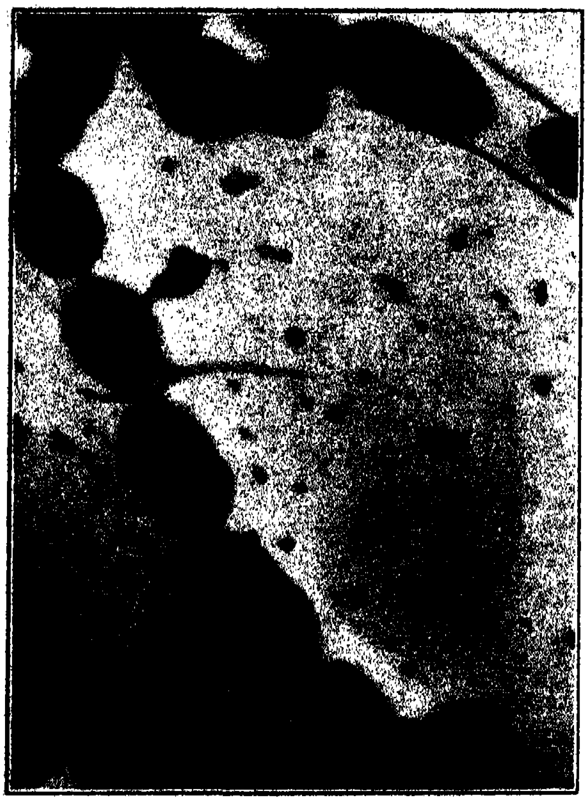

FIG. 4. Streptococcus germs. Magnification 20,000 ×.

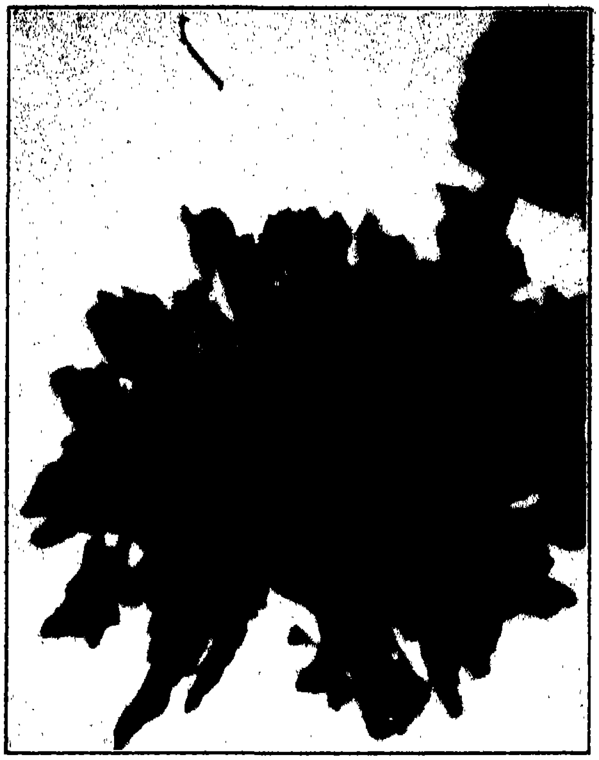

FIG. 5. Iron-oxide powder (rouge). Magnification 15,000 ×.

tically relative to the objective. This arrangement makes it an easy matter to explore the specimen by manipulating controls from the observer's position.

In studying the object the observer is seated in front of the microscope and views the final image through one of the large rectangular windows provided for that purpose, with the current and voltage controls within easy reach. A periscope at the left end of the window permits the observation of the less highly magnified intermediate image from the same position.

If a photograph is to be taken, a photographic plate is introduced through a second airlock, the fluorescent screen is swung aside and an exposure made. The airlock mechanism opens and closes the plate holder automatically as the plate is introduced and again withdrawn.

To illustrate some possibilities of application of this electron microscope, a few pictures obtained with it are reproduced in Figs. 2 to 5. The first three represent various pathogenic bacteria. Here the long curved flagella of the typhoid germ and the interior structure visible in the whooping cough bacteria are particularly interesting. The last picture, showing a sample of polishing rouge, indicates the usefulness of the instrument for determining the size and shape of particles beyond the reach of the light microscope.

A conservative estimate based on the examination of pictures so far obtained makes the resolving power of the present electron microscope twenty times that of the best light microscopes with oil immersion. There is every probability that research now being carried on will greatly increase this factor. The significance of this newly found sight, extended to the range of the larger organic molecules, in all branches of science—biology, medicine, metallurgy, etc.—can scarcely be gauged. Once again, an apparently insurmountable obstacle to the progress of science has been overcome.

SCIENTIFIC EVENTS

THE HARVARD SCHOOL OF DENTAL MEDICINE

A NEW plan of dental education made possible by contributions amounting in all to $1,300,000 has been inaugurated at Harvard University. The gifts were made by: The Carnegie Corporation, $650,000 in addition to a gift of $350,000 made in 1937; the Rockefeller Foundation, $400,000; and the John and Mary R. Markle Foundation, $250,000. This foundation had contributed previously the sum of $25,000.

Under the plan, which is described in the *Harvard Alumni Bulletin*, the present Harvard Dental School will be renamed the Harvard School of Dental Medicine. Its course, to be initiated in the autumn of 1941, will be extended from four to five years, and will combine in increased measure the basic knowledge and skills of both medicine and dentistry.

Dental students will register in both the new School of Dental Medicine and in the Harvard Medical School, taking three and a half years of the same medical courses as other students in the Harvard Medical School, and in addition one and a half years of specific dental training. Graduates will receive both the M.D. and D.M.D. degrees. Admissions to the School of Dental Medicine will be governed by the same standards and the same committee which govern admissions to the Harvard Medical School.

In the first year of the five-year course, students will spend approximately five per cent. of their time in specific dental training, and the remaining 95 per cent. in medical training. The proportion of dental training will rise to 10 per cent. in the second year, 20 per cent. in the third year, 37 per cent. in the fourth year, and 88 per cent. in the final year.

In addition to the contributions of the three foundations named, the president and fellows have transferred definitely to the resources of the School of Dental Medicine $1,000,000, tentatively placed at the disposal of the school ten years ago. An additional $250,000 is required to bring the plan into operation; but it has been announced that there is expectation of finding a means to provide this balance. It has been decided, accordingly, to proceed with the plan. When this last balance is provided, the permanent new assets for teaching and research will amount to $2,550,000.

THE GUGGENHEIM FELLOWSHIPS FOR LATIN AMERICANS

BRAZILIAN scholars, competing for the first time for the Latin American fellowships offered by the John Simon Guggenheim Memorial Foundation, have been awarded six of the nineteen fellowships granted for 1940–41. Three fellowships were granted to Peruvians. Argentina, Chile, Uruguay and Puerto Rico each received two fellowship awards, Mexico and Cuba one each.

Fellowships in the sciences include:

CARLOS NICHOLSON JEFFERSON, professor of the physical geography and climatology of Peru in the University of San Augustín, Arequipa, will engage in comparative studies of the climates of the Peruvian coast and the coast of California.

DR. FERNANDO HUIDOBRO TORO, surgeon and member of the staff, Catholic University of Chile: Studies of the chemical transmission of nerve impulses.

DR. RAUL PALACIOS, chief of the section of filterable viruses of the Bacteriological Institute of Chile: Studies of rabies.

DR. AMERICO SANTIAGO ALBRIEUX MURDOCH, head of the section of endocrinology, Institute of Endocrinology, Montevideo, Uruguay: Studies in the field of endocrinology, in particular, hormone therapy.

DR. CIRO A. PELUFFO, assistant in the Department of Bacteriology, Institute of Hygiene, Montevideo, Uruguay: Studies of artificially induced microbiological variation.

DR. HUGO PABLO CHIODI, laboratory chief, Pulmonary Research Center, University of Buenos Aires: Investigation of respiratory phenomena caused by muscular activity in health and disease.

DR. EDUARDO ETZEL, chief surgeon, Clemente Ferreira Tuberculosis Institute, São Paulo, Brazil: Technical studies of thoracic surgery in relation to the treatment of pulmonary tuberculosis.

DR. NILSON TORRES DE REZENDE, surgeon, Pernambuco, Brazil: Studies in the field of neurophysiology.

DR. MAURICIO ROCHA E SILVA, member of the staff of the Biological Institute of São Paulo, Brazil: Research into the pharmacological properties of trypsin.

CARLOS ARNALDO KRUG, head of the Genetics Department, Institute of Agronomy of São Paulo, Brazil: Genetic investigations of citrus and other major crop plants of Brazil, in collaboration with experts of the United States Department of Agriculture.

JOSÉ P. CARABIA, assistant in the Botany Department of La Salle College, Havana, Cuba: The preparation of a work on the flora of Cuba, at the New York Botanical Garden, where there is gathered the world's largest collection of Cuban plants.

NABOR CARRILLO FLORES, professor of mathematics, National University of Mexico: Studies of soil mechanics and its application to the construction of foundations of buildings and dams with especial references to the difficult subsoil conditions of Mexico.

FACUNDO BUESO-SANLLEHÍ, associate professor of physics, University of Puerto Rico: Studies in the field of band spectra. Professor Bueso-Sanllehí, who has taught at the University of Puerto Rico since 1927, was born in Mexico.

MARIO SCHENBERG, acting professor of physics, University of São Paulo, Brazil: Research into the application of nuclear and atomic physics to astrophysics.

The grants are made in terms of fellowships to assist research workers in all fields of knowledge to carry on their work under the freest possible conditions. The stipends granted are usually $2,000 for a year.

Dr. Frank Aydelotte, director of the Institute for Advanced Study at Princeton, is chairman of the Committee of Selection. Members of the committee include: Dr. Thomas Barbour, professor of zoology and director of the Museum of Comparative Zoology of Harvard University; Dr. Elmer Drew Merrill, Arnold professor of botany and administrator of the botanical collections of Harvard University, and Dr. Percival Bailey, professor of neurology and neurosurgery in the medical school of the University of Illinois.

FELLOWSHIPS OF THE ZOOLOGICAL SOCIETY OF SAN DIEGO

THE Zoological Society of San Diego announces that two fellowships are available to advanced graduate students for the pursuit of research work at the San Diego Zoological Research Laboratory on some phase of animal biology (concerned primarily with such branches as pathology, bacteriology, parasitology, physiology, comparative anatomy, comparative biochemistry, animal nutrition or animal psychology). The stipend of each scholarship is $1,000 per annum.

The Zoological Hospital and Research Laboratory is supported by public appropriations and endowed funds, and is devoted to problems concerned with the health and normal life of animals, in and out of captivity, and to various phases of biological research. It is conducted in connection with the San Diego Zoological Gardens, which house 3,000 animals, including 175 species of mammals, 500 species of birds and 150 species of reptiles.

Research facilities include a two-story building with individual laboratory and office rooms. Refrigeration, incubation, x-ray equipment, microphotographic apparatus, microtomes, microscopes, etc., are available in the building. An extensive outdoor animal isolation yard houses all new animals and research material. New animals are continually arriving from different parts of the world, often presenting special problems in nutrition and health. There is a wealth of material for pathological, parasitological and anatomical study from the Zoological Gardens and other cooperating agencies.

Since the Zoological Research Laboratory is not directly affiliated with any university, it is desirable that the recipient of the scholarship work under the direction of the department from which he applies and preference will be given to candidates for an advanced degree, it being understood that only the thesis or dissertation requirements or parts thereof can be fulfilled at the laboratory.

The Research Committee of the institute is comprised of a group of local biologists who participate in the activities of the hospital and laboratory by invitation of the Board of Directors of the Zoological Society without compensation. Their counsel is available to students and research workers. Seminars are held at regular intervals.

Further information will be sent upon request. Applications should be forwarded to Chas. R. Schroeder, Zoological Research Laboratory, Balboa Park, San Diego, Calif., before June 15, 1940.

AWARD OF MEDALS OF THE ROYAL GEOGRAPHICAL SOCIETY

IN his presidential address at the annual general meeting of the Royal Geographical Society on June 24, Field-Marshal Sir Philip Chetwode announced, according to the London *Times*, that it was the pleasure of the King, the patron of the society, that the council of the society should make this year its usual recommendation for the award of the royal medals. He approved these recommendations, but signified that the gold medals could not be struck until after the war.

The Founder's Medal was awarded for the first time in the society's history to a man and his wife jointly, for the work done for geography by Mr. and Mrs. Harold Ingrams was indivisible. The president paid tribute to their work in connection with the Wadi Hadhramaut. The Patron's Medal was awarded to Lieutenant Alexander R. Glen, of the Royal Navy, for his expeditions in Spitsbergen and in North-East Land, in one of which he maintained two stations on the Ice Cap throughout the winter and established a whole new technique of wintering under the worst conditions and keeping perfect health.

The Victoria Medal for conspicuous merit in scientific geography was awarded to O. G. S. Crawford, archeology officer of the Ordnance Survey. The Murchison Grant was awarded to Peter Mott for his surveys in West Greenland. The Back Grant was awarded to Gerald Seligman for his glacier studies conducted last year on the Jungfraujoch. With a small team of specialists working in a laboratory which was excavated in the glacier curtain, and so kept automatically at freezing point, he had obtained important evidence of the method by which the snow of the névé became transformed into the ice of the glacier, and on the process of movement.

The Cuthbert Peek Grant was awarded to John Hanbury-Tracy for his work in southeastern Tibet and his more recent journey in South America. The Gill Memorial was awarded to Alexander King for his work in Jan Mayen in 1938.

THE NEW HAMPSHIRE MEETING OF MATHEMATICIANS

THE American Mathematical Society, the Mathematical Association of America and the Institute of Mathematical Statistics will meet at Dartmouth College from September 9 to 12. Before the American Mathematical Society a series of four colloquium lectures by Professor G. T. Whyburn, of the University of Virginia, on "Analytic Topology" will be given on Tuesday morning and afternoon, and on Wednesday and Thursday mornings. Professor Leonard Carlitz, of Duke University, will give an address entitled "Arithmetic of Polynomials in a Galois Field" on Thursday afternoon. There will be a joint session on Tuesday afternoon with the Institute of Mathematical Statistics. At a session of the institute on Wednesday morning Professor J. L. Doob, of the University of Illinois, will speak on "Probability as Measure" and

Professor R. von Mises, of Harvard University "On the Foundations of Probability and Statistics"; on Thursday morning there will be addresses by Professor J. Neyman, of the University of California, on the "Estimation by Intervals as a Problem in Classical Probability" and by Dr. J. F. Daly, of the Catholic University, on "Statistical Estimation in Large Samples."

The Mathematical Association will hold two sessions on Thursday, one in the morning and one in the afternoon.

A joint dinner of the societies will be held on Tuesday evening at seven o'clock in Thayer Hall. On Monday evening at 8 o'clock there will be an entertainment in Dartmouth Hall, followed by an open house. During the evening there will be an exhibition of a collection of string models of ruled surfaces constructed by Professor Robin Robinson.

On Wednesday afternoon there will be an excursion to Franconia Notch in the White Mountains. Busses will leave Massachusetts Row at 1:30 P.M. It is expected that the busses will return to Hanover between 8 and 9 P.M. A picnic lunch *en route* is planned.

RECENT DEATHS

Dr. Charles Puryear, dean emeritus of the Agricultural and Mechanical College of Texas, died on July 11. He was seventy-nine years old. Dr. Puryear was professor of mathematics at the college from 1890 to 1932.

Arthur Holmes Howell, senior biologist of the Bureau of Biological Survey of the U. S. Department of Agriculture, now a division of the Fish and Wild Life Service, died on July 10 at the age of sixty-eight years. Mr. Howell became a member of the staff of the Biological Survey in 1895.

Dr. Alvah Horton Sabin, consulting chemical engineer of the National Lead Company, died on July 8 at the age of eighty-nine years.

Dr. Joseph Williams Schereschewsky, medical officer in charge of cancer investigations of the U. S. Public Health Service, associate in preventive medicine and hygiene at the Harvard Medical School, died on July 9. He was sixty-seven years old.

The death is announced of Dr. Hans Virchow, professor of anatomy at the University of Berlin.

Nature records the death of Sir Thomas Hudson Beare, regius professor of engineering in the University of Edinburgh, on June 10, aged eighty years; of Oliver Gatty, research chemist, aged thirty-two years, and A. S. Chessum, research engineer, aged twenty-seven years, during an experiment in connection with air-raid precautions, on June 5; of Sir Jocelyn Thorpe, emeritus professor of organic chemistry of the University of London and in the Imperial College of Science and Technology, on June 10, aged sixty-seven years. Sir Arnold Wilson, distinguished for his administrative work in India and Persia, chairman of the British Industrial Health Research Board from 1926 to 1933, has been reported by the War Office as missing.

SCIENTIFIC NOTES AND NEWS

Dr. Richard C. Tolman, of the California Institute of Technology, has been elected vice-chairman of the Defense Research Committee recently appointed by President Roosevelt with Dr. Vannevar Bush, president of the Carnegie Institution of Washington, as chairman. Brigadier General G. V. Strong, assistant chief of staff of the Army, and Rear Admiral Harold G. Bowen, director of the Naval Research Laboratory, have been assigned to this committee as representatives, respectively, of the War and Navy Departments. Other members of the committee are: President Karl T. Compton, of the Massachusetts Institute of Technology; President James B. Conant, of Harvard University; Dr. Frank B. Jewett, president of the National Academy of Sciences, and Commissioner of Patents Conway P. Coe.

The new laboratory of the National Advisory Committee for Aeronautics, at Moffett Field, Calif., will be named for President Emeritus J. S. Ames, of the Johns Hopkins University, who was chairman of the committee for twenty years before his retirement last autumn.

Harold Earle Thompson, vice-president and chief engineer of the Carbide and Carbon Chemicals Corporation, New York, N. Y., received the degree of doctor of science from West Virginia University at its commencement exercises in recognition of "outstanding contributions to the fields of engineering and chemistry and his part in the development of the chemical industry of the Kanawha Valley."

Colgate University has conferred the doctorate of science on Charles Edward Wilson, president of the General Electric Company, and on Dr. Richard H. Hutchings, retired superintendent of the Marcy State Hospital at Utica.

In addition to the awards in Group I for exhibits of individual investigation, which are judged on the basis of originality and excellence of presentation, made at the recent meeting in New York City of the

American Medical Association, which were reported in the issue of Science for June 21, awards were made to a second group not exemplifying purely experimental studies but judged on the basis of excellence of presentation and correlation of facts. In this group the gold medal was awarded to Norman Treves, Memorial Hospital, New York, for an exhibit illustrating the significance of the bleeding nipple; the silver medal to A. H. Logan, P. W. Brown, J. A. Bargen, H. M. Weber, L. A. Buie, H. H. Bowing, A. H. Baggenstoss, C. F. Dixon, J. deJ. Pemberton and C. W. Mayo, of the Mayo Clinic, Rochester, Minn., for an exhibit on Polyps of rectum and colon, and the bronze medal to W. H. Wright, National Institute of Health, for an exhibit illustrating the public health aspects of trichinosis.

Dr. Bernard W. Hammer, professor of dairy industry at Iowa State College, has been presented with the Borden Award in recognition of outstanding research in dairy science. The award, consisting of a gold medal and $1,000, was given at the annual convention of the American Dairy Science Association at Purdue University. Professor Hammer's most recent research has contributed to improvements in the flavor and quality of cheese and butter.

Nature states that a joint committee of the Royal Society of Edinburgh, of the Royal Physical Society and of the Royal Scottish Geographical Society has awarded the Dr. W. S. Bruce Memorial Prize (1940) to Brian Roberts, Emmanuel College, Cambridge, "for his valuable work in survey, ornithology and general biology in the north and south Polar regions."

The Goethe Medal for art and science of the German Government has been awarded to Dr. Heinrich Ewald Herring, professor of normal and pathological physiology at Cologne; to Dr. Ludwig Kiessling, professor of agriculture and plant industry at Munich, and to Dr. Arthur Wehnelt, professor of physics at Berlin.

The Union of German Chemists has awarded the Carl-Duisberg Memorial Prize to Dr. Hans Brockman, docent in organic chemistry at Göttingen, and the Adolf Fick Prize for physiology to Dr. Karl Lohmann, professor of physiological chemistry at Berlin.

Officers of the Society for the Promotion of Engineering Education have been elected as follows: *President,* Donald B. Prentice, Rose Polytechnic Institute; *Vice-presidents,* L. E. Conrad, Kansas State College, and E. L. Moreland, Massachusetts Institute of Technology; *Secretary,* F. L. Bishop, University of Pittsburgh; *Treasurer,* W. O. Wiley, New York City, and *Assistant Secretary,* Nell McKenry, University of Pittsburgh. *Members of the Council* elected for a term of three years are: C. S. Ell, Northeastern University; W. Otto Birk, University of Colorado; H. A. Curtis, University of Missouri; A. R. Cullimore, Newark College of Engineering; H. E. Degler, University of Texas; D. P. Savant, Georgia School of Technology, and George T. Seabury, American Society of Civil Engineers. The 1941 meeting will be held at the University of Michigan from June 23 to 27. The meeting for 1942 will be held in New York City.

Dr. Frederick C. Waite, for thirty-nine years a member of the faculty of the School of Medicine of Western Reserve University, retired at the end of the academic year with the title professor emeritus of histology and embryology.

Dr. George Wagoner has been appointed professor of orthopedic research and director of the Laboratory of Research in Orthopedic Surgery in the Graduate School of Medicine of the University of Pennsylvania.

Dr. Z. I. Kertesz, associate in research in chemistry at the New York State Agricultural Experiment Station, Geneva, and assistant professor of chemistry at Cornell University, has been promoted to be chief of chemical research at the station and has been promoted to a professorship of chemistry at the university.

Colonel Glen E. Edgerton, U. S. Army, engineer of maintenance at Panama, has been named governor of the Panama Canal.

Dr. R. B. Jacobs, formerly instructor in physics at Harvard University and Lalor Fellow at the Massachusetts Institute of Technology, has been appointed assistant secretary of the National Research Council. He took up the work on July 15.

The *Journal* of the American Medical Association states that Dr. William T. Green, assistant professor of orthopedic surgery, Harvard Medical School, has been made director of the after-care clinic of the Harvard Infantile Paralysis Commission. Dr. Green has charge of one of the two main divisions of the scientific work of the commission. The clinic in the Children's Hospital cares for about 1,400 children annually and conducts investigations of methods of treatment of infantile paralysis and of its after-effects. Dr. William Lloyd Aycock, assistant professor of preventive medicine and hygiene, Harvard Medical School, is in charge of the division of laboratory research, including study of the causation and epidemiology of the disease. The commission was established by the Harvard Corporation in 1916.

Dr. William Cramer, a German by birth, for more than twenty-five years a member of the Imperial Cancer Research Fund, London, has joined the staff of the Barnard Free Skin and Cancer Hospital, New

York City, where he will study the early stages of cancer in animals. The appointment of Dr. Cramer has been made possible by an anonymous donor, who provided sufficient funds to bring him to the United States for a year.

NEWTON B. DRURY, of the California State Park System, has been appointed to succeed Arno B. Cammerer as director of the National Park Service. Mr. Cammerer has been transferred to Richmond, Va., where he will serve as regional director. Miner R. Tillotson will be transferred from the directorship of Region One to that of Region Three, covering the Southwestern states, with headquarters at Santa Fe, New Mexico. Colonel John R. White, now regional director at Santa Fe, will be transferred to San Francisco, Calif., to take up there the work of regional director of Region Four, in the Far West, and Frank A. Kittredge, regional director of Region Four, will become superintendent of Grand Canyon National Park, Arizona.

Nature reports that Dr. S. S. Bhatnagar, professor of chemistry at the University of Lahore, has been lent for two years to the Government of India as director of scientific and industrial research.

ACCORDING to the London *Times* the trustees of the Lady Tata Memorial Fund have decided that if circumstances permit grants will be made during the academic year beginning on October 1 to defray the expenses of research in blood diseases, with special reference to leukemia. Grants have therefore been tentatively awarded to Dr. M. P. J. Guérin, Paris; Professor K. Jármai, Budapest; Professor E. L. Opie and Dr. J. Furth, New York; Dr. A. H. T. Robb-Smith, Oxford; Dr. Werner Jacobson, Cambridge.

PHILIP E. PRATT, who recently received the doctorate in organic chemistry at the State University of Iowa, and Allison S. Burhans, a graduate of Duke University, have been appointed members of the research and development staff at Bloomfield, New Jersey, of the Bakelite Corporation, Unit of Union Carbide and Carbon Corporation.

DR. LOUIS A. KAZAL, of Rutgers University, has been appointed a member of the staff of the Biochemical Laboratory of the Medical Research Division of Sharp and Dohme, Glenolden, Pa.

DR. ENRICO FERMI, of Columbia University, recently gave a lecture on "Energy Production in Stars" at the University of Chicago, where he is visiting professor of physics.

DR. M. RUIZ CASTANEDA, director of the Department of Medical Research of the General Hospital, Mexico City, has returned to Mexico after visiting scientific institutions in the United States. He gave lectures on his work on typhus before the Rockefeller Institute for Medical Research, New York City; the Hoagland Laboratories, Brooklyn; the Institute of Medicine, Chicago, and the Mayo Foundation, Rochester, Minn.

THE council of the British Medical Association has decided, in view of the present situation, not to hold the annual representative meeting provisionally arranged for July 19 and 20.

THE Semicentennial of the Biological Laboratory at Cold Spring Harbor, now of the Long Island Biological Association, was celebrated on June 29, 1940. Addresses were made by Arthur W. Page, president of the association; Professor Harold C. Urey, of Columbia University, and Dr. Robert Cushman Murphy, of the American Museum of Natural History. After a tea at Blackford Hall a series of exhibits was shown at the John D. Jones Laboratory, including among others the electric potentials of the electric eel, the living frog heart and of a marine algal cell, Valonia, and the application of electrophoresis to protection against allergies. In his address Dr. Urey stressed the importance of the Cold Spring Harbor Symposia and the appreciation of men of science of the people of the community who as patrons of the laboratory have given it financial aid and active interest. Dr. Murphy emphasized the special value of the laboratory due to its location inside the metropolitan district and the part it has played in improving biological instruction.

THE Massachusetts Institute of Technology has established a department of building engineering and construction, of which Professor Walter C. Voss has been appointed chairman. Associated with him on the staff will be Professor Dean Peabody, Jr., Howard R. Staley and Albert G. Dietz. The program of the new department will be based on the work of the course in building engineering and construction, which for several years has been given in the department of civil and sanitary engineering.

DISCUSSION

THE SAMPLING ERROR OF THE MEDIAN

IF σ be the standard deviation of a universe about its mean, the standard deviation of the mean of random samples of n drawn from the universe is always $\sigma/\sqrt{n}$, no matter how small n may be. The classic example of a universe for which the sampling error of the mean is infinite is

$$\varphi = \frac{1}{\pi}\,\frac{1}{1+x^2} \qquad (1)$$

for which σ is infinite. It is usually pointed out that the median of this universe is $x=0$ and that the standard deviation of the median of random samples of n drawn therefrom is obtainable from the usual formula

$$\sigma_M = \frac{1}{2\varphi_M\sqrt{n}} \qquad (2)$$

where φ_M is the value of φ at the median M, or, here, $\sigma_M = \pi/(2\sqrt{n})$ and is finite.

That the formula (2) for the standard deviation of the median can not be universally valid like the formula $\sigma/\sqrt{n}$ for the mean may be seen from considering the two functions

$$\varphi = \frac{3}{2}x^2,\ |x| \leqq 1 \qquad (3)$$

$$\varphi = \frac{1}{4}\frac{1}{\sqrt{|x|}},\ |x| \leqq 1 \qquad (4)$$

in the first of which $\varphi_M = 0$ so that (2) would make σ_M infinite, although it is surely less than 1, and in the second of which $\varphi_M = \infty$ so that (2) would make $\sigma_M = 0$, although that is highly improbable.

As a matter of fact, if one refers to the proof of (2) as ordinarily given, one sees that it depends on the formula $1/(2\sqrt{n})$ for the standard deviation of the fraction (½) of the n values in the sample which fall to one side of the median of the universe, and that this deviation $1/(2\sqrt{n})$ is converted into a deviation of the median of the sample itself by assuming that the area $\varphi_M\sigma_M$ is $1/(2\sqrt{n})$. When the function φ is changing very rapidly at its median M it would seem that a better statement of this assumption would be

$$\int_{-\sigma_M}^{\sigma_M} \varphi\, dx = \frac{1}{\sqrt{n}},$$

where the origin for x had been taken at the median of $\varphi(x)$. Indeed if this be used in the two cases above it will appear that

$$\sigma_M = \frac{1}{\sqrt[6]{n}} \quad \sigma_M = \frac{1}{n} \qquad (5)$$

respectively, instead of ∞ and 0, and that the standard deviation of the median need not vary inversely as the square root of the number in the sample.

However, though the result is better, it is not perfect. It would be necessary to have recourse to a true expression for σ_M. If n be odd, as $n = 2k+1$, the median of the sample will be the middle element. If

$$F(x) = \int_{M=0}^{x} \varphi(x)\, dx$$

the chance that the median of the sample be at x is

$$\psi(x)dx = \frac{(2k+1)!}{(k!)^2}(\tfrac{1}{2}+F)^k(\tfrac{1}{2}-F)^k\varphi dx$$

The mean value of the median of random samples will not in general be at the median of the universe (taken as origin), though it must be so for a symmetrical universe, to which we shall here confine our attention; then

$$\sigma_M^2 = \int x^2\, \psi(x)dx, \qquad (6)$$

where the integration is extended over the whole range of the function φ.

If this formula be applied to (3) and (4) we find, respectively,

$$\sigma_M^2 = \frac{1}{\sqrt{\pi}}\frac{\Gamma\left(\frac{n}{2}+1\right)\Gamma\left(\frac{5}{6}\right)}{\Gamma\left(\frac{n}{2}+\frac{4}{3}\right)} \text{ and } \sigma_M^2 = \frac{3}{(n+2)(n+4)}$$

where Γ denotes the gamma function. If Stirling's formula be applied to the Γ-functions, it may be shown that for n large the variation of σ is according to the powers of n indicated in (5) but that the coefficients are not unity but approximately 0.90 in the first case, whereas it is 1.73 in the second.[1]

If (6) be applied to (1) it may be shown that for random samples of $n=3$ drawn from that universe the standard deviation of the median would be infinite, but for $n=5,7, \ldots$ would be finite. Finally, the application of (6) to

$$\varphi = \frac{4}{(e+|x|)[\log(e+|x|)]^2}$$

will show that the standard deviation of the median of samples of $n=2k+1$ will be infinite, no matter how large n may be,[2] although the function φ has a sharp beak ($\varphi_M = 4/e = 1.5$) at $x=0$, and appears to fall away very rapidly as x increases, being less than .007 at $x = \pm e$.

EDWIN B. WILSON

HARVARD UNIVERSITY

THE PUBLICATION OF ISIS

THE publication of *Isis*, an international and polyglot quarterly devoted to the history and philosophy of science, was begun in Belgium in 1912–13. Hardly had five issues appeared (Volume 1 and the first half of Volume 2) when the publication was stopped by the German invasion. After the war Volume 2 was completed and distributed without extra charge to the

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[1] The general case $\varphi = C|x|^{-p}$, with $|x| < 1$ and $p < 1$, leads to $\sigma_M^2 = 1/n^\alpha$ where $\alpha = 1/(1-p)$ by the area argument, whereas by the usual formula it leads to 0 or ∞ according as p is positive or negative, but by (6) to the value

$$\sigma_M^2 = \frac{\Gamma(\alpha+\frac{1}{2})\Gamma\left(\frac{n}{2}+1\right)}{\Gamma(\frac{1}{2})\Gamma\left(\frac{n}{2}+1+\alpha\right)} = \frac{\Gamma(\alpha+\frac{1}{2})2^\alpha}{\Gamma(\frac{1}{2})n^\alpha}$$

(approximately for n large).

It may be noted that for no value of p (except $p=0$ and $\varphi \equiv \frac{1}{2}$) in this sequence of frequency functions does the standard deviation of the median vary inversely with the square root of n.

[2] This would appear to be true for any symmetrical φ for which

$$\int_x^\infty \left(\int_x^\infty \varphi(x)dx\right)^k x^2\varphi dx$$

diverges for every value of k.

early subscribers,[1] and further volumes were gradually issued; they were edited in the United States, but printed in Brussels, later in Bruges. On January 12, 1924, the History of Science Society was founded in Boston, *in order to guarantee and promote the publication of Isis.* The editor undertook to give the subscribers each year a volume of about 600 pages. In fact during the last sixteen years (1924–39) the members received not sixteen volumes, but twenty-five (Volumes VI–XXX).

This year Belgium was again invaded by the same enemy, and the publication of *Isis* was again interrupted. At the time of this second invasion several issues of *Isis* were in various stages of printing, to wit, No. 84 completing Volume 31 and the whole of Volume 32.

No. 83, though dated November, 1939, was so much delayed that it reached America only in 1940; we count it as the first number of 1940 (outside of it, our members received 648 pages in 1939). The corrected page proofs of Nos. 84 and 85 were mailed to Belgium on March 27 and May 8, respectively. The neutrality of Belgium was violated by Germany on May 10.

Members of the History of Science Society[2] having paid their subscription for 1940 will receive at least No. 84 without charge, as soon as it appears.

From 1941 on (Volume 33 *ff.*) *Isis* will be printed in the United States. The first American number will include a list of all the papers and reviews which were scheduled to appear in the last Belgian issues (No. 84 and Vol. 32). Authors of these papers and reviews are welcome to publish them in other journals, but they should warn the editors to whom they apply that publication in *Isis* is not abandoned and may occur sooner than we think.

The capacity of the American *Isis* will probably be smaller than that of the Belgian predecessor, but the editorial policy will remain essentially the same. In the face of the moral and social chaos endangering the whole world it is more necessary than ever to study as well as possible our most precious heritage, the heritage not of one nation but of the whole of mankind. It is equally necessary to interpret the philosophy and inwardness of science, of which our machines, whether they be useful or destructive, give us only a very imperfect and deceiving idea. The main function of the scientist is to approach nearer to the truth and to publish the results of his investigations as faithfully as he can. The purpose of *Isis* is to explain our past efforts in that direction and thus help us to continue them in the same spirit of devotion to truth and humanity.

Let me add a few words about *Osiris,* which was founded in 1936 in order to relieve *Isis* of the longer papers, and thus to increase its capacity, variety and attractiveness. *Osiris* serves the same purpose as *Isis* but is restricted to longer papers; it is not supported by the History of Science Society, and hence subscriptions to it or correspondence relative to it should not be addressed to the secretary of the society, but to Dr. Alexander Pogo, Harvard Library, 189, Cambridge, Massachusetts. At the time of the German invasion two volumes of *Osiris* were being printed, to wit, Volume 8, dedicated to Paul Ver Eecke, historian of Greek mathematics, and Volume 9, dedicated to Max Meyerhof, historian of Arabian medicine. These two volumes will appear in due time, and we trust that they will be followed by many others.

GEORGE SARTON

HARVARD LIBRARY 185

ZOOLOGICAL SOCIETY OF LONDON

THE effect of the war upon scientific societies in Great Britain is being felt in various ways, chiefly in reduced membership, accompanied by higher paper and printing costs for their scientific publications. In normal times the Zoological Society of London spends about £3,000 a year on its scientific publications—comprising the *Transactions* and the two series of *Proceedings.* But the society draws by far the greater part of its revenue from the shillings and sixpences of the general public who visit the London Zoo and Whipsnade.

During the war, the attendance of visitors has fallen to about one quarter of normal, so that, in spite of the utmost economy in running costs, and in spite also of the loyalty of its fellows (the total is still over 8,000, only a few hundred less than a year ago), it is operating at a very heavy loss. Thus, since the outbreak of war, it has only been able to publish about half the normal volume of work, and this will have to be further cut down in the near future. Meanwhile, papers are still being submitted in almost peace-time quantity, so that the publication of valuable work is being seriously delayed.

The society has stocks of its scientific publications—"Proceedings," "Transactions," "Zoological Record" and "Nomenclator Zoologicus"—for sale. Those desirous of completing their files of these works will, by purchasing lacunae *now,* materially assist the society in the continuance of its activities in these difficult times. *Bis dat qui cito dat:* help would seem to be urgently required if the society is not to break its long record of well over a century and suspend scientific publication (as well as some of its other activities) during the continuance of the war.

JULIAN S. HUXLEY

ZOOLOGICAL SOCIETY OF LONDON

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[1] SCIENCE, 49: 170–71, 1919.

[2] Secretary-treasurer, Dr. H. R. Viets, 8 The Fenway, Boston.

SCIENTIFIC BOOKS

ELECTRICAL DISCHARGES IN GASES

Fundamental Processes of Electrical Discharges in Gases. By Leonard B. Loeb. Pp. xviii + 717. 297 figures. New York: John Wiley and Sons, Inc. 1939. $7.00.

It is the author's objective to present "the reader with the facts and conflicting views, and . . . thereafter throw the weight of his authority in whatever direction it should, in his opinion, go, giving his reasons in each instance." This aim establishes the tone of the treatment, which is refreshingly outspoken. There is always a full discussion of the facts which form the basis for the author's judgment. The style is clear and incisive.

The presentation has been systematized in a way that is a real help in grasping essentials in a situation. Advantages and disadvantages of a method, assumptions underlying a theory, alternative mechanisms in a process, and so on, are throughout consistently listed seriatim, 1, 2, 3, etc.

The detailed treatment accorded to many of the methods, particularly those used in investigating the properties of ions, gives the book almost the character of a laboratory manual in places.

The first three chapters as well as the sixth are devoted to ionic behavior—the measurement of ionic mobilities, the experimental data and mobility theory, the recombination of ions, their diffusion, and the formation of negative ions. This amounts to one third of the book. The author's great interest in ionic behavior has led him to go into historical and experimental details which would be in place in a monograph on gaseous ions. Here they distract attention from other aspects of gas discharges and even crowd some of these out.

A chapter on electron mobility serves as an introduction to a thorough treatment of the energy distribution in an accelerated stream of electrons. The Druyvesteyn, Morse-Allis-Lamar and Smit derivations are all given. The important effect of electron interaction in creating a Maxwellian distribution in glows and arcs is, however, only mentioned in one sentence and a single reference. Nor is the effect mentioned of the positive ions in a plasma in decreasing the electron mobility.

The important subject of probes is competently discussed, and is concluded with a pertinent section on sources of error in probe measurements. The author is slightly handicapped, however, because the space-charge limited current problem and allied problems are postponed to a later chapter, with no perceivable advantage.

Ionization by electron collision is treated statistically and the relation is derived between Townsend's α and the differential ionization just above the ionization potential. But the general course of the differential ionization curve as well as values of total ionization and the formation of multiply charged ions are not discussed.

Another chapter is devoted to the second Townsend coefficient. It includes a critical discussion of spurious effects and summarizes alternative explanations.

An excellent treatment of sparks in the penultimate chapter is divided into three parts: theory, techniques in study and special types of breakdown including, among others, vacuum sparks, corona and lightning.

One reaches the final chapter on glows and arcs realizing that although one of the important applications of electrical discharges is to lighting, there has been no treatment of excitation and radiation.

Unfortunate confusion arises in this last chapter between glow and arc, and low and high pressure discharges. A "positive column" section under the glow discharge really deals with the low-pressure glow *or* arc, while a similar section under arcs deals with the high-pressure arc. The same is true of the two "anode fall" sections. Thus, the generally false impression is created at this point that arcs can not be low-pressure affairs and that they can not have low current densities.

This chapter is inadequate in other respects. The low-pressure positive column in which ions fall, without impact, to the wall is not mentioned although it has had far better experimental confirmation than the quasi-neutral diffusion case. It would be desirable to know what the effect is of a magnetic field on the arc and that current limiting factors exist. Of comparable importance to sparking is the disappearance of ionization after the interruption of an arc and the application of such de-ionization to the thyratron principle, but this is not discussed.

There are three appendices, one on the kinetic nature of a gas, the others consisting of a table of critical potentials and a table of physical constants.

The extremely comprehensive author and subject indices as well as the wealth of direct references are valuable features.

Lewi Tonks

General Electric Company,
Schenectady, N. Y.

THE ULTRACENTRIFUGE

The Ultracentrifuge. By The Svedberg and Kai O. Pedersen, in cooperation with J. H. Bauer, E. G. Pickels, G. Boestad, E. O. Kraemer, J. B. Nichols,

O. LAMM, A. S. MCFARLANE, R. SIGNER. Pp. x + 478. 174 figs. New York: Oxford University Press. $12.50.

AN ultracentrifuge is defined by Professor Svedberg as a centrifuge in which convection-free sedimentation can take place. Such an instrument is a valuable tool, first for the determination of particle or molecular sizes and weights and, second, for the purification or concentration of various materials. In this book the authors deal principally with the first of the above applications, together with the design and construction of the various types of ultracentrifuges which they have used.

About four fifths of the book is written by the two principal authors, The Svedberg and K. O. Pedersen, and one fifth by the cooperating authors. Each of the contributors is especially well qualified to discuss his particular topic and the book is thoroughly authoritative.

The subject-matter is divided into four parts. Part I is a detailed and critical discussion of the theory of sedimentation by Svedberg and Pedersen, with a chapter at the end by Kraemer. The equations are derived for the two cases usually employed for the determination of particles or molecular sizes and weights, *i.e.*, for sedimentation equilibrium and for sedimentation velocity. The theory of sedimentation equilibrium is discussed, not only for uncharged particles and molecules but also for the case of salts, colloidal electrolytes and mixtures where equilibrium exists between several components.

Part II describes the construction and operation of the various types of ultracentrifuges. A most interesting review is given by Svedberg, Boestad, and Pedersen of the development of the Svedberg ultracentrifuges, as well as a detailed description of his most recent types now in use at Upsala. These include both the low-speed centrifuges used mostly for sedimentation-equilibrium measurements and the high-speed oil turbine ultracentrifuge with which Professor Svedberg and his students have carried out so many epoch-making experiments. The discussion of the design and construction of the rotors and cells are of special interest to any one interested in centrifuge design, since the principles may be used for any type of rotor. Part II closes with a valuable chapter by Bauer and Pickels on the air-driven ultracentrifuges which they have used in their work.

Part III gives a most useful discussion of the methods of measuring the concentration gradients in the ultracentrifuge cell which are necessary for the determination of molecular or particle weights and sizes. The authors of this part are Pedersen, Lamm, and Kraemer.

Part IV deals with the results obtained with the Svedberg ultracentrifuges. The first section, written by Pedersen, presents and discusses the results obtained with animal and plant proteins. McFarlane contributes a chapter on the plant virus proteins. The second section presents the results on organic colloids (except proteins) and is written by Kraemer, Nichols, Signer, and Pedersen.

The appendix contains tables of constants and other data necessary for calculating the results from the experimental data. The bibliography contains practically a complete list of papers dealing with ultracentrifuge technique and data.

Although, as stated in the preface, the authors have confined themselves to a discussion of their own types of ultracentrifuges and the results obtained with them, the theory and methods presented are largely applicable to any type of ultracentrifuge. Also, the results are illustrative of the usefulness of the ultracentrifuging technique. Professor Svedberg and his collaborators have rendered a great service in writing this indispensable handbook to every one interested in using any type of ultracentrifuge or in the interpretation of sedimentation data.

J. W. BEAMS

UNIVERSITY OF VIRGINIA

SPECIAL ARTICLES

ON THE IDENTITY OF VITAMIN H WITH BIOTIN

IN a recent communication[1] we called attention to the possible identity of vitamin H, the curative factor for egg-white injury in rats,[2] with biotin,[3] a growth factor for yeast, and with coenzyme R,[4] a growth and respiration factor for many strains of legume nodule bacteria. The identity of biotin and coenzyme R had already been indicated by other investigators.[5,6] Our conclusion that vitamin H and biotin were either identical or very closely related compounds was based on the close parallelism that was found to exist in the distribution and in the chemical and physical behavior of the substances, as brought out both by our own experimental work and by data derivable from the literature.

It was found that no important differences in distribution could be discovered, when the differences in sensitivity of the assay methods for vitamin H and for biotin and coenzyme R were considered. The solubilities of these three factors in various organic solvents, their heat stability, low molecular weight, adsorption phenomena, stability toward acid and alkali and the effects of reagents such as nitrous acid, benzoyl chloride, acetic anhydride and lead acetate, all pointed to the probable identity of the factors. The strikingly parallel distribution of biotin, coenzyme R and vitamin H activities in the electrodialysate fractions from our vitamin H liver concentrates added particularly convincing evidence for the identity of the three factors. Additional work on biotin and vitamin H which we have since carried out brought still further confirmation.

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[1] P. György, D. B. Melville, D. Burk and V. du Vigneaud, SCIENCE, 91: 243, 1940.

[2] P. György, *Jour. Biol. Chem.*, 131: 733, 1939.

[3] F. Kögl and B. Tönnis, *Zeits. Physiol. Chem.*, 242: 43, 1936.

[4] F. E. Allison, S. R. Hoover and D. Burk, SCIENCE, 78: 217, 1933.

[5] P. M. West and P. W. Wilson, SCIENCE, 89: 607, 1939.

[6] R. Nilsson, G. Bjälfve and D. Burström, *Naturwissenschaften*, 27: 389, 1939.

Conclusive proof of the identity of these principles, as we previously noted, had to await the testing of the pure substances for the mutual activities. This has now been facilitated through the kindness of Professor F. Kögl, who has placed at our disposition for vitamin H assay a solution of 150 γ of crystalline biotin methyl ester in ethyl alcohol. We wish to take this opportunity to express our sincere appreciation for this generosity and cooperation.

In order to obtain some indication of the level at which the biotin methyl ester should be tested for vitamin H activity by the rat assay method, the yeast-growth activity of this solution was compared with that of a solution of known vitamin H activity. A modification of the method of Snell, Eakin and Williams[7] was employed, using *Saccharomyces cerevisiae* Strain 139 as the test organism. Yeast growth was determined by turbidity measurements in the Klett-Summerson photoelectric colorimeter. The curve obtained by plotting turbidity readings against the logarithm of the concentration of the substance being assayed was used to determine the concentration at which half the maximum increase in growth occurred. The half-maximum growth increase was found to be more accurate than either maximum or minimum growth concentrations for comparison of various samples in the calculation of activity. It was found that biotin methyl ester produced a half-maximum growth increase at a concentration of 1 part in 4×10^9. A vitamin H preparation containing 34 units of vitamin H activity per mg produced the same yeast-growth effect at a concentration of 1 part in 1.36×10^7. It could be predicted, therefore, that the biotin methyl ester should show an activity of approximately 10,000 units of vitamin H per mg by the rat assay method if biotin and vitamin H were identical.

Twenty-six rats showing definite vitamin H deficiency symptoms[2, 8] were used for assay of the solution of crystalline biotin methyl ester at various levels above and below the amount indicated by the yeast assay. Subcutaneous administration of the biotin ester brought about complete cure of the skin manifestations and resumption of growth in these animals. The minimum effective dose, within the limits of assay error, was found to be 0.1 γ per rat per day for 30 days. This corresponds to an activity of 10,000 units of vitamin H per mg for the methyl ester of biotin. The most potent vitamin H preparation hitherto reported[1] possessed an activity of 215 units per mg.

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Donald B. Melville[9]
Department of Biochemistry,
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MOBILIZATION OF VITAMIN A BY ALCOHOL

The important observation of Clausen *et al.*[1] that, in dogs, vitamin A is mobilized from tissue stores by ethyl alcohol, as shown by actual blood analyses, probably applies also to humans. The Pett visual test for vitamin A deficiency,[2] has been correlated with blood analyses.[3] Using this instrument, routine daily tests have been carried out on many people during the past two years. On several occasions unaccountably short recovery times (indicating higher blood vitamin A levels) have been observed the day following the taking of alcohol. Table I shows a few such incidental observations.

TABLE I

Subject	Recovery Times			
	Previous average	1st day after alcohol	2nd day after alcohol	7th day after alcohol
	seconds	seconds	seconds	seconds
A	9	5	6	8
B	10	7	8	9
C	15	8	..	12
D	19	9	9	16

* Smaller values equal higher blood vitamin A.

The observations of Clausen and his colleagues would now appear to explain these findings.

L. B. Pett
University of Alberta

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[7] E. E. Snell, R. E. Eakin and R. J. Williams, *Jour. Am. Chem. Soc.*, 62: 175, 1940.

[8] "Medicine in its Chemical Aspects," Bayer, Leverkusen, Germany (1938), Vol. 3, p. 137.

[9] S.M.A. Corporation Fellow.

[1] S. W. Clausen *et al.*, Science, 91: 318, 1940.

[2] L. B. Pett, *Jour. Lab. Clin. Med.*, 25: 149, 1939.

[3] L. B. Pett, and G. A. LePage, *Jour. Biol. Chem.*, 132: 585, 1940.

ENZYMATIC LIBERATION OF AUXIN FROM PLANT TISSUES

RECENTLY it has become increasingly clear that the quantitative extraction of auxin from green tissues by the use of solvents is attended with considerable difficulty. In a study of this problem,[1] using *Lemna minor*, grown under controlled conditions, as source material, and the standard *Avena* method for auxin assay, we have found that complete removal of the auxin present is obtained only after repeated extractions spread over a period of several months. This is true even when ether, which was found to be the most suitable solvent, was used. It is true also for a number of different plant tissues.

The results which we have obtained by several methods demonstrate that the slowness of the extraction is due to the very gradual liberation of free auxin from some bound form. From the behavior of the material in regard to boiling and drying, it was deduced that this liberation is in the main enzymatic and probably hydrolytic in nature. In order to hasten the extraction, the effect of adding some proteolytic enzymes, available in pure form, has been investigated. It was found that crystalline trypsin brings about a small increase in yield, while chymotrypsin was highly effective under the conditions used. When duplicate samples of ground and dried *Lemna* were allowed to stand 24 hours at pH 8 and room temperature, and then acidified and extracted with ether, the yield of auxin was increased from 20 units in the control to 93 units in the enzyme-treated sample. Incubation with the enzyme at 37° C was still more effective.

In the table are given the results of one such experiment. Fresh *Lemna* was rapidly dried, kept at 70° C overnight, ground and divided into samples weighing 0.365 gms, corresponding to 3.0 gms fresh weight each. Water was added to all samples and some were boiled for 15 minutes. Another sample was cytolysed with ether, ground thoroughly with water, and the extract divided into two 3 cc portions. All samples were brought to pH 8 with Na_2CO_3, enzyme added where necessary, and the final volumes of the solutions brought to 2 cc. After 24 hours' incubation at 37°, the samples were acidified and extracted with ether (first extraction). They were then kept under ether for two further periods of 7 and 8 days, respectively, and the extracts so obtained, together with the rinsings, also tested.

Table I shows that both in the boiled and unboiled material, the enzyme increases the yield from three to four times. In another experiment increases as great as six times have been obtained with as little as 0.1 mg enzyme. Controls on the chymotrypsin solution alone, either fresh or carried through the procedure above, gave in 3 out of 4 experiments no auxin at all; on one occasion 12 units per 5 mg were obtained. The greatly increased auxin yield could therefore not be the result of either active impurities or decomposition products of the enzyme itself.

TABLE I
EFFECT OF CHYMOTRYPSIN ON THE YIELD OF AUXIN FROM LEMNA MINOR*

	First extraction	Second + third extraction	Total
		Unboiled material	
Control	250	310	560
Chymotrypsin 1 mg ...	1144	884	2028
Chymotrypsin 5 mg ...	638	982	1620
		Boiled material	
Control A	138	157	295
Control B	203	89	292
Chymotrypsin 1 mg ...	469	582	1051
Chymotrypsin 5 mg ...	313	505	818
		Water extract	
Control	101	114	215
Chymotrypsin 5 mg ...	280	118	398

* All data in units per cc per 3 gms fresh weight.

The results with the water extract are suggestive rather than significant, but they are included because they set an upper limit to the amount of activity which could possibly have been contributed by the enzyme.

It may be concluded that the auxin in *Lemna* is bound to a protein, from which it is liberated on hydrolysis. It is probable that this conclusion applies to a variety of plant tissues.

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[1] Details of the work will be published elsewhere.

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REMARKS ON PROFESSIONS IN MEDICINE[1]

By Dr. ALFRED E. COHN

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THIS invitation of yours to speak here to-night I regard as no ordinary honor. Once before you offered me this same opportunity. Ten years ago seems so far behind us as to have occurred almost in another life time. Some of you must remember that through a long hour you were patient. And now you ask me again. You give me the chance of feeling a deep satisfaction in the belief that I was tried and was not found wanting. We both take a great risk. I take mine willingly. For there are things as to which I believe I shall feel the better for having shared my thoughts. Nor can I think of men and women with whom I prefer to share them better than with you. We have, as it were, through long personal friendships, established common points of view which, on such occasions as this, come to some sort of systematic expression.

But I can not begin without recalling that I was brought here originally by Jack Wyckoff, whom I have always cherished as one of the most gifted of my friends. His gifts were not the gifts of tinsel—he did not shine by any of the arts that compel the immediate and spontaneous admiration of other men. Quite otherwise. His virtues came to be impressed upon us by their sheer weight—massive things which, because they were exercised in right directions, came to be understood to be expressions of deep intelligence and actuated by profound human sympathy. Wyckoff understood, I think, that the profession of medicine is so inextricably embedded in the social forces of our, indeed of any, time that it is a distortion of the facts to think of its position as something isolated. To him the life of a physician was not circumscribed by the content of his immediate profession but transcended such narrowing confines. Had he been spared so he could develop the bases of his beliefs, I feel reasonably confident the remarks I am about to make would have expressed his own views. I have as you see, an abiding faith in the possibility of his indefinite growth.

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[1] Read before the Alpha Omega Alpha (Honorary Fraternity), Delta Chapter of New York, January 24, 1940.

I believe in two things—one, that socially and intellectually we are the inheritors of our past and bound by it and, second, that it is possible for farseeing and determined men powerfully to change our direction and to influence our future—the future of our kind. We must be mindful though that the sum total of human experience has been small. Small as it is, it has been won at the expense of incredible suffering and toil. We may, as human beings, represent little in a cosmic sense. But toil and suffering are not things we care, or should care, lightly to bestow on our descendants, unless we choose to be utterly cynical. Our other path is to become conscious, by meticulous exploration of our past, of what its meaning has been and to try to discern whether that experience points a desirable way hereafter.

We know that in our dark and not so very ancient history, white men in civilized communities became, chiefly as prisoners of war, literally slaves. That was a practise of man's inhumanity to man which, as far as expression of belief is concerned and the hope of amelioration, came to an end with the Christian revolution 2,000 years ago. Belief and expression, though, are one thing, and the practise of life another. The extent to which actual human bondage is still practised and the variety of forms which the dominance of man by other men still assumes, it would surprise us, I think, if we passed in review: the social forms in the Far East and in the somewhat Nearer; the industrial forms almost everywhere; the political forms which, due to doctrinal disguise, are operative in so many regions. Even of actual individual human slavery, the world is far from being free. Feeling for the sufferings of other human beings—compassion, the good-will which rejoices because other men have been given the opportunity to realize their highest potentialities, the best that is in them, that pervading sense of the worth and the dignity and the potential decency of men, that which makes us speak of the value of the individual man—these are the basis of the entire theory of our profession. It is because we have beliefs that we are a profession. For I take it that profession means belief—belief that a form of life can be devised as the result of which there is rendered to other men, service. And service may involve sacrifice—sacrifice, disinterested indeed to the point where life, even if not always cheerfully lost, is at least dedicated to achieving a greater measure of welfare for common men less favorably situated, or less favorably endowed. If you run through your minds the names of the professions, my meaning becomes clear—medicine, law, the military, theology, engineering. You wonder perhaps at the inclusion of certain ones because you notice that there have slipped in as professions, ways of life from which, in the general belief, sacrifice is or has been departing and the notion and the object of gain or of profit has entered.

But let me not take you too far afield. Let me continue to insist that at the basis of a profession is concern for the welfare of individual men—their worth, their dignity, their suffering, their opportunity. It is to that concern I wish to attach the word "compassion." As I think, the watershed of all human thought, of all human organization, of all human aspiration, is this divide. There can be only two ways —concern for individual men or the subordination of individual men to interests which transcend their personal welfare. How our world is divided in its views on this issue requires no emphasis on my part. But here, in conception, lies a parting of the ways of which we can not pretend to be oblivious. For the profession of medicine it is crucial.

There is a second strain in the life of medicine, often, perhaps usually, regarded as its dominant strain —the intellectual strain. Systems or methods or the content of education are the reflections, sometimes very pale, of contemporary knowledge. For many and complicated reasons, that knowledge is not always conveyed in its essence—it is misunderstood or it is misrepresented. A minimum, the part that is palatable, comes out unscathed. Sometimes the accumulations of the past seem to be regarded as of little account. That must be because teachers prefer, not always wisely, to devote themselves to values believed to possess greater validity because they possess greater currency to-day.

But ideas have long lives. One of our great contemporaries believes, indeed, that being once born they march down through the ages having histories of their own. It is an engaging view. The point is not so much that questions which nature suggests to us to ask remain unchanging in their formulation as that a way of looking at nature once suggested keeps being insistent, sometimes more, sometimes less, the intensity of the search for an answer varying with special and general circumstances. I remind you that the uses to which the heart and the blood and the blood vessels are put, engaged the attention of naturalists very early. They (the Naturalists) kept coming back century after century to an attempt at solution, always thinking that an answer had been found, but never aware of the inaccuracy or the inadequacy of those answers. We think now that we have been making and are making great strides toward understanding. And we are. But let me remind you also that in a very real sense, we possess small likelihood of thinking of kinds of mechanisms except those which lie reasonably close to our hands. And yet, in connection with the circulation and its mechanics, the questions we can and do ask for which there is not even an approach to an answer are very startling. I am thinking, in the heart, of so essential a part of its mechanism as rhythm—rhythm itself being a phenomenon widely recognized as occurring in many aspects of nature, without in most situations our having the remotest notion as to how to proceed to find an answer to our inquiry concerning its origin or its nature.

I may be permitted to keep looking for illustrations for my thesis in the domain of the heart. Beside rhythm, of equal importance, is contraction. With the unfolding nowadays of precise knowledge on how a substance, expressed in its chemical formula, is translated into another one through direct action or through the intermediation of enzymes and of other substances, whether proteins or not, the way ahead seems long before, with any assurance, we can predict a time or a situation, about which one can say, this is the end of our journey. And in this same domain of contraction, though surprising increases in knowledge have occurred since Hill and Meyerhof studied in its simpler phases the glycogen-lactic acid cycle, the gap between that mechanism and the behavior of the protein, myosin, to name the chief constituent of muscle, is wholly untouched. And yet we are entitled to believe that, compared with what Aristotle knew or Galen, or Vesalius, or Fabricius, or Harvey, or Lavoisier, or even Tigerstedt or Starling, the difference appears to be that between poverty and wealth. There is an important sense though in which that difference can be exaggerated. Aside from the accumulation of actual information, what should concern us is the cerebral power, that power of mastery in the face of mystery which the mind of man knows how to exhibit in unravelling the intricacies of nature. It makes no difference to us whether what they accomplished, now seems simple. That will be what our descendants are like to think of us. The form in which criticism is practised in the East is relevant here. There it is the function of critics to put themselves in the place of creative artists or indeed of creative scientists. There is, I think, no fundamental difference between the two. That function is *Einfühling,* a quality which makes it possible to feel into the original creative situation. If we compass this act there is little doubt we shall appreciate that the intellectual capability exhibited then was of an order similar to any shown nowadays. Discoveries and the content of discoveries are new. But the flights of which the imagination is capable—are they higher now than then?

We are wont to think that the intellect, like the wind, bloweth where it listeth. Even if this were true I doubt whether I, or whether anyone, could trace under what influences and in what environments, men have come to think what they did in building the content of our culture. Of the two main schools of opinion, that the mind has been free roaming in search of its interests and that it has moved within frameworks dictated by the needs and temper of a time, there is still no final decision. Most of us believe that we are, even if we have not always been, free agents; that what we do to succeed is exactly adapted to what we should do. We take the general view that these are matters which have been thought out and can therefore be dismissed because they have passed successfully through the fiery furnace of experience.

But let us pause a moment. Let us pass by the Greek thinkers, though even in their schools there was sharp discussion of what, in the way of doctrine, should and should not be taught, and pause when we come to those first centuries of this era when other worldliness drove out all interest in the concerns of this world. Something, it now seems certain, remains of the old interests in the west of Europe, but, it seems, not much—legacies but not practise. And these legacies were best preserved in the outskirts of the Mediterranean, not at its center—in Arabia, in North Africa, in Spain. Not until there was need for codifying and teaching the Cannon Law did the semblance of systematic instruction return to Europe. The mind was not free to roam, not in the case of Copernicus, nor Galilei, nor Vesalius, though it roamed delightedly in the realms that were attempting to make order in the conceptual world—concerning God, destiny and salvation. Later, by not more than three centuries, with a new orientation, inquiry about the real world began again. But it took less than another 100 years from the publication of "De humani corporis fabrica" (1543) to that of "De motu cordis" (1628) before teaching had become so crystallized in the universities that academies were founded in Italy, England, France and Germany to struggle with the problem of how to get on with the advancement of natural knowledge. Evidences of such struggles are to be found in many places, dealing with many subjects.

Nor did medicine escape. It is necessary to recall that although there was systematic instruction in medical subjects, more especially anatomy and anatomy perhaps alone, beginning with the closing centuries of the Middle Ages, studying diseases and observing therapeutic successes did not begin until the sixteenth century. In the University of Paris, teaching Harvey's discovery that the blood circulates, was out of the question. To escape from dictation by the vested interests, the more active enquirers founded and were aided in founding by the Government, the Collège de France and the Académie des Sciences. In England in the sixteenth century knowledge was so sedimented and crystallized in Gresham College, that a forward movement, though having its forward impulse and seat there, came to be more hospitably received at Oxford in the so-called "Invisible College," later to be competently protected under the charter of the Royal Society. But it was medical subjects rather than medicine or medical disciplines in the form of a curriculum leading to a degree and the right, in any modern sense, to practice that came into existence. At the end of the eighteenth century at Speyer, Johann Peter Frank, a layman, a Minister of State, faced problems having to do with the public health without benefit of medicine. But it was in the eighteenth century that what we now recognize as the semblance of a curriculum began to appear.

What I am trying to emphasize in this random recital is that old as is the enquiry concerning the behavior of the body, both in health and in disease, interest in learning the nature of its processes without older prejudices, coupled with an interest in anything like a systematic form of teaching, are the inventions of very recent years. You will, I think, look in vain for periods in which there existed belief in complete *freedom* of inquiry, even when there was an inquiry at all. It is a mistake to think that the tradition of free inquiry is ancient, or so well established, that it can be taken for granted as one of the secure possessions of our society.

The contention then is that the curriculum, as an expression of belief, is reasonably recent; that the curriculum once accepted, itself has tended to undergo a succession of crystallizations; that each one of these crystallizations has tended to become a rock-like deposit so that force was required on more than one occasion to blast a way clear to permit newer ideas again to flow. And my moral is that, in this background, it is of the utmost importance to be on guard against perceived and of course unperceived repetitions of these catastrophes. You will not need to be convinced that my account of the situation at somewhat older periods is reasonably fair. But you will not be content with the inference that we need to-day to be vigilant unless I offer examples for my statements. I am speaking, you remember, of the intellectual strain in medicine, its vicissitudes, its checkered fate. Perhaps the most striking example that occurs to me is in the domain of medical psychology. Thirty years ago, in any ordinary sense, such studies were not so much ignored as not even considered. The mind of man had a place in nature, but not in the medical curriculum—except it be what was roughly called insane. The mind anyway, as has recently been so plentifully emphasized, though it is an important instrument in our existence, found little favor in the attention of serious students because, so far as could be told, it dealt with what Descartes termed secondary and not primary qualities. Then came an era, under the leadership of Charcot and Breuer and Freud in which an attempt to be serious about behavior was attempted. Since Freud's death it has been possible for Burt to say in *Nature:*

> Freud was, indeed, one of the boldest and most original of thinkers. Nevertheless, the isolated items in his theories were by no means so novel as is popularly supposed. Both in Great Britain and in America a strong reaction against the intellectualistic psychologies of the nineteenth century had already set in. James and Stout had emphasized the need for a more dynamic psychology; McDougall had urged the importance of unconscious motives, particularly in the instinctive and emotional life; Janet had emphasized the importance of dissociation in mental disorder and disease; Havelock Ellis had attempted a scientific study both of dreams and sex. Freud's own great achievement was perhaps to incorporate what was most fruitful in these ideas in a single, striking, unifying system, and to collect a vast amount of empirical data from a wide variety of sources, all illustrating much the same fundamental mechanisms of the mind.

But Freud was given no place in the University of Vienna either to study or to teach. His examination of the problems with which he dealt was not undertaken in any university in England; and in this country, although Hall was sufficiently concerned with this issue at Clark University to invite Freud to come there, there is still, so far as I know, no place in any university, except at Harvard University and there, not in the medical school but in the Department of Psychology, where these studies are welcome.[2]

I wish I were competent to search out and to set before you the reasons for this exclusion. If I venture to do so at all it is with the utmost trepidation and for no other reason than to find a gross example for a thesis I want in a moment to examine. It is not as if what I am about to say is invention of my own—in years past I have on many occasions taken part in and listened to conversations in which I learned that these were the views of many other men. To our great credit, be it said, it is well recognized that aberrant behaviors are among the commonest of the causes that send patients to physicians. That physicians are inadequately prepared to cope with such situations is recognized everywhere and the fact deeply deplored. But—to do anything to relieve this situation presents great difficulties. Our methods are not applicable to the analysis of these maladies. Is it unfair to point out that science is *only* a way of thinking about nature and that there was science before kymographs, manometers, galvanometers and Roentgen rays—perhaps even before weights and measures? These are the methods it is now respectable to employ. Until other appropriate ones become acceptable, it is not the part of respectability to meddle with them.

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[2] I have recently been told that psychiatrists who have been psychoanalysed are teaching in the University of Chicago. And the same statement may be warranted of other institutions. But that is not quite the same as having made an open provision for this form of teaching in medical schools.

But if you regard this situation in medical psychology as exaggeration, let me recall that all advance with the aid of the intricate apparatus of laboratories was regarded as taboo by leaders of our profession no less recently than a single generation ago. Meetings and space in journals were devoted to disquisitions on the perils to which medicine was about to be exposed by men willing to devote all their time to current methods in the study of diseases. The echoes of that controversy are not yet dead, but times have materially changed, and quickly—it has now become respectable to attempt analytical methods. Let me recall further that our system was lacking in that there existed nothing essential except the professors, for whom the enterprise was on the whole chiefly a profit-making business. Obtaining a degree was a matter of having paid a fee. The course had no fixed length nor was it graded. Grading began in 1859 in the medical department of Northwestern University in Chicago—a three-year graded course. At Harvard College grading began in the early 1870's. And in a serious way it began at the Johns Hopkins in 1893 when the bachelor's degree was required for admission. There were no laboratories until 1878 when Dr. Delafield established one (The Laboratory of the Alumni Association at the College of Physicians and Surgeons) and until in the same year Dr. Welch opened a pathological laboratory, with private funds, I believe, at the Bellevue Hospital Medical College.

I want next to examine one aspect of the state of research in medicine and to draw lessons from the past to suggest that a forward advance is conceivably hindered by our current arrangements. It is not at all an infrequent experience in our hospital at the Rockefeller Institute that men come applying for posts at 27 to 29 years of age. The assumption when they come is naturally that what they desire is to devote their energies to the advancement of learning—to research. But there are among the applicants also men who, it turns out, intend rather to teach than to investigate and others still who wish to enter private or public practise. Recently among them was a very engaging and intelligent man who had decided that teaching was to be his career. He wanted instruction in the varieties of cardiac diseases. He wished to see intimately cases illustrating the senescent, the infectious, the toxic forms. After a period spent in observing one variety he wanted, much as internes do, to move on to another service—from mine, for example, to Doctor Swift's. I explained the situation; if you came for a year or two and had embarked on an investigation, presumably of significance—the chances were that when your time is up, you would still be far from having completed the written report of your experiences—to say nothing of attempting to savor one complicated subject after another. He understood, this lad, very well, when the situation was made clear. He was disappointed though because, when he entered practise as he intended to do, he would not have seen as correctly as he should have done cases of this or that named disease. He came from one of the better schools. That lad seemed to me to be laboring under a tragic misconception. He did not see that to the extent principles exist in groups of diseases, the essential thing in any discipline is to understand those principles, the general rules—that knowing all about individual so-called diseases was to attempt to assume a burden greater than was at all necessary and intellectually very uneconomical. But he went even further and wondered, indeed I think he doubted, whether there were value to him as a teacher in knowing something of the methods of research. I infer that I made my points in vain, for he decided against our plan of training.

I find this experience important. The fact that it has become customary to carry on research in university clinics is evidence of the wide belief that this practise has advantage. And those advantages ought to be vividly appreciated. To make clear to anyone the nature of a current conception, especially on the part of teacher to student, it has seemed desirable that the story of the growth of that piece of knowledge should be told and retold in a lively fashion. The story so often suggests the origin, purpose and success of an adventure. Going actually through the mechanics of performing a research is as lively a way as any of becoming sensitive to the history of how knowledge grows. And a teacher I should think would be the more effective the more he knew such stories at first hand. But then this is all commonplace and well known. Every one does not become a good teacher, no matter how much he obeys the rules of the game. But anyone can become a better teacher if he knows how knowledge has been acquired so that he can tell stories rather than present completed pictures. I had hoped that that lad would depart a wiser, even if a sadder man. But no; he was not persuaded.

Of course there is much to the making of teachers beside having acquaintance with the dynamics of research. Undoubtedly, aside from the immediate content in subject matter, how to teach has a technique. I can not be greatly in error in supposing that in *preparation for teaching, the subjects which* are included in the curriculum of a medical school, how to combine the various elements in each—content, technique and history—still requires thoughtful canvass. Otherwise I could not have had my recent experience.

To that other subject to which I referred briefly just now, I want also to direct attention. I am aware that I am about to tread on dangerous ground, that it is ground with which I am insufficiently familiar, that what I think, at least now, before you have set me right, is open to serious criticism. I am persuaded though that the subject is important and merits very careful study if the advancement of knowledge in the study of diseases is to be in a healthy situation. It is unnecessary to speak of preparation for investigations of problems in morphology or in physiology or in that aspect of morphology and physiology combined which is biological chemistry. These are subjects of wide and general interest which would be undertaken even if there were no diseases—subjects which healthy men would venture to study to enlarge their comprehension of this world. But the matter of studying diseases—that is where a perplexing difficulty compellingly presents itself. There are several ways of approaching its analysis—I shall attempt two. First, let me speak of the case of a determined student, man or woman, arrived at the age of 29, now confronted, perhaps not for the first time, with what next to do to become a responsible investigator. At the age of 29, he or she has done what the curriculum prescribed. There are *in point of fact few persons* who have the hardihood to ignore what is prescribed and I have recently learned again of the cases of men who were warned against making the attempt even of adopting bio-chemistry as a career except under the aegis of the medical curriculum and the medical school with the imprimatur of the degree of doctor of medicine. There is, of course, in this debate, a valuable argument in favor of knowing the background, as the curriculum presents it, of a discipline in which students design to carry on investigations. But need it be the whole, unmodified, time consuming and in part irrelevant curriculum? How much more hazardous would it be in point of fact for one intending to study diseases to proceed on an original course exactly and broadly calculated to fit him for his enterprise?

But it is desirable to turn aside to look at the medical curriculum. It is, is it not, a rigid structure, designed to acquaint students with what experienced persons regard as indispensable to those who engage in the practise of medicine. In part, the structure is responsive to a sort of historical blackmail exercised by Boards of Regents when they construct examinations for the license to practise. The Regents themselves are the victims of the historical process and *system. And* so history, the future, the Regents and the faculty combine to make the curriculum what it has become. So far as the fair, enticing, irrelevant world is concerned the curriculum is partly shafts and partly blinders. Do I exaggerate when I say it contains a great mass of necessary elements, no doubt, but from any single or many points of view, often ill assorted? Is it incorrect to believe that it contains subjects or parts of subjects which are taught because once they were regarded as relevant to current knowledge? The history of curriculums is the history of succeeding beliefs. We hold beliefs longer than we should and do not permit them to be dislodged when they *should* be, by novel discoveries and situations. We make our curriculums rigid so that revolutions are necessary to make room for new ideas. Conventions have such momentum that we teach them far beyond the time when they represent truth—to the exclusion of novelty. Novelty then grows up outside of schools and is later either forcibly admitted or becomes so potent as to exert disruptive force. I am not referring, as earlier, to the historical aspects of relevant subjects but to subjects which either need not be taught because they have no practical bearing or to subjects which, even if they have, receive a devotion in the time spent upon them out of all proportion to what is necessary, if there were introduced suitable latitude in the techniques of instruction. I am speaking of the mere saving of time. Of course I have been reminded that learning consists not only in becoming acquainted with subject matter but as much with the *duration of familiarity with that subject*, and that success is a function of the length of time we have the opportunity or the necessity of holding that subject matter in our consciousness. These are debatable matters. Indeed I am prepared to have you demonstrate to me that there is now in the curriculum nothing useless, that there is no misuse of time.

In that event we are at an impasse. Students, not many perhaps but a few and very important ones, have in good faith passed through our schools and their interne periods—the periods of their major impressionability. They are 27 to 29 years old and when they come to us they must be told that the time is all but passed for them to become professional investigators. Of all of this I have seen tragic consequences. It is the more tragic when you reflect that in other disciplines, in other natural sciences, in physics, and in chemistry and in subjects such as mathematics, great discoveries have been made before this age of 27 to 29. But even if late, why has it become at least doubtful whether a medical school is so constituted as to be a good training ground for learning how to carry on research in diseases? What the situation is in the study of diseases is, of course, familiar to you. I pass over that compartmentalization of diseases which has made it merely conventional to separate infectious diseases from those exhibiting predominantly chemical or physiological aspects. But these are essential differences when the time comes to apply the techniques of analysis. When that time comes it is also familiar to you that the comprehension that issues from analysis is obtained now, as no doubt it always was, not at the level of organization at which diseases, or indeed any phenomenon exists, but at a level more general and more simple, less organized, less special, than the obvious and apparent aspect which the whole integrated action presents. And nowadays whether a disease is metabolic or immunological or physiological so-called, essential investigation begins to take place at a level not at all obvious. How hormones actually operate, how muscle contracts, how the body defends itself against attack from infectious agents is to understand that mechanism in terms which do not in the least disclose themselves to the immediate attention either of patients or physicians. Naturally it would be absurd to say that an end has come to the opportunity for therapy on irrational grounds. One need not have so great confidence in the operation of the mind as to suppose that only through its mediation are far-reaching discoveries to come about. Contrariwise though, rational therapeutics can not be supposed to be dependent upon the comprehension of the superficial processes actually encountered. But to investigate at those levels of organization in disturbed or diseased organisms at which malfunction occurs seems to suggest on the part of investigators the possession of technical competence which can be acquired apparently only through long familiarity with the thinking and the techniques which are requisite in elucidating the mechanisms which are actually in operation. At 29 it is too late for most men on the threshold of economic responsibility, even if it were possible intellectually, to undertake essential reorientations in order to acquire the necessary equipment. I speak with feeling. Perhaps men will always be speaking with similar feeling in the sense that similar surprises lurk in store for all of us—we live on into unfamiliar eras. We are not spared like Cato, knowledge of the greater Rome. And in these days we live very fast. I am, if you please, not to be misunderstood; there are multitudes of collateral sources of interest and opportunities for the display of intellectual energies. Whatever other situations exist, this one, on which rational analysis depends, begins seriously to be removed from the opportunity of men arrived at 27. The inescapable consequence of this situation is that if problems now recognized as capable of solution are to be solved, salvation must result from the activities of men trained not as physicians are trained now. Other men, whether chemists or physicists or physiologists must be drawn into the service. Physicians who have first acquaintance with the phenomena and meaning of diseases must step aside from careers of this sort of adventure and limit themselves to the care of the sick. This is a noble and engrossing enough calling. But the serious and unfortunate question remains—must physicians insist upon such self-denying ordinances, when the opportunities for a different arrangement of study have not adequately been explored? In that case physicians have trained themselves so as to become incapable of investigating, at an appropriate level, the very subjects of their deepest concern. The result is deplorable only if one thinks it so. Many do. Indeed there are many physicians who think that the recognition and understanding of such special phenomena as diseases are not likely to be studied as successfully by others as by those whose especial concern and responsibility they are. A compromise has often been effected through association of physicians with other scientists. That may be the necessary conclusion of the matter. And yet—there are men of 27 who desire a different solution.

What I have been saying earlier is that it may be possible, by taking thought, finally to add a cubit to our intellectual stature. We may be able to guide men who wish to find themselves in different positions at 27, into different channels—either in our schools or through flexible arrangements elsewhere in the universities. If suitable arrangements can be made within the schools, a signal advantage would be gained through the simultaneous presence under protection of men of similar ultimate interests, of varieties of students actuated by similar motives, devoted to similar ends and separated only by the different approaches to those ends. Ten years ago I entered a plea in this company for mutual understanding among all of us devoted to the service of different aspects of our lives in medicine. I am reverting to that subject. What I have observed in the interval is that the old Adam still struts among us, that all the differences in temperament have not been bridged. Men still fall into strata. They still practise their snobberies. It is a little soon to expect the heaven, we hope, all of us, to establish on our earth. But now when we begin to understand better what the elements of our problem are, I ask seriously whether this situation should not be taken into review. Whether we can not find ways in which within the schools, means can not be found for educating men, within a faculty of the medical sciences, to undertake the variety of services which lie open to us. Men of 21 are perhaps not too young to declare, provided the facts have been placed before them, wherein their dominant interests lie. Life is too hard and competition too keen, much longer to permit ourselves the luxury of *not* knowing. You will say, the trouble lies farther back, in school and college—and I agree. We begin, all of us, to recognize the fact that the physical frontier has disappeared only to find that instead of being far away and out of reach, it has moved close to our very doors. There are new frontiers; we must choose, young and early, which one we are to cross and within which one we are to find home. We know anyway—most of us. We can be aided by discerning advisers. The various careers in medicine can then be harmoniously developed. Diseases can be competently studied. Their analysis need not be delayed or made complicated by requiring the collaboration, no matter how eager and willing, on the part of men of different outlooks and trainings and interests.

Whether the problem I present can be solved in the way I suggest makes little difference. I am more interested in raising doubt lest we be betrayed by our sense of security—doubt lest we conclude that what has once been adopted is eternally established. The history of intellectual organization, as this has been illustrated in the behavior of universities, I have suggested, does not necessarily encourage us to conclude that there is nothing left to suspect or to learn.

There is no other profession which requires of its members so great a range of responsibilities—the whole gamut of human concerns from irrational to rational. Response to suffering is the *fons et origo* of our motivation. The history of man has made us aware at least of this, exemplified in St. Francis, that sensitiveness to suffering is bred in our beings. We could not escape the motive of compassion if we would. But to be effective, we must, in this very necessity, collectively put hard heads at the service of soft hearts. There lies the difficulty of our complex professional existence. Somehow we must harmonize our dual nature. That may, hereafter, turn out to be more difficult than ever it has been. But the success of our test will be measured in the degree to which we recognize our double obligation and embrace our double opportunities.

SCIENTIFIC EVENTS

THE PRINTING PRESS OF LEONARDO DA VINCI

THERE was an informal private opening of an exhibition of the scientific achievements of Leonardo da Vinci at the New York Museum of Science and Industry on Wednesday, July 24.

Correspondents have called attention to a quotation in the issue of SCIENCE for May 24 in regard to the printing press of Leonardo, stating that it antedated the press of Gutenberg. This is obviously impossible, as Gutenberg died in 1468 and Leonardo was born in 1452. In regard to the press of Leonardo, SCIENCE has received from a correspondent the following details:

> To ascribe a definite date and a definite locality to Leonardo's printing press would be quite impossible because of the lack of authoritative records. Suffice it to say that the machine was put into actual operation somewhere in Italy towards the end of the fifteenth century.
>
> Leonardo's exhaustive mechanical studies and applications proved very helpful in enabling him to produce a machine much more practical than that of Gutenberg's, in that it could be operated by one man in a comparatively simple manner.
>
> Movable type was cast of lead and placed in a shallow basin on a very heavy wooden car equipped with rollers. Once the type was in position the actual printing was a very simple matter, requiring but the turning of a solid wooden cylinder threaded at both ends, which turning caused several simultaneous things to happen. A large cogged wheel on the top of a very massive wooden frame engaged with cogs on the upper end of a long pipe, which rotated rapidly, causing the rope connected to the car to wind on a roller, thereby pulling the car into position under a heavy wooden block, which, lowered because of the turning, provided the pressure needed for the impression.
>
> Turning the cylinder in the opposite direction raised the weight and let the car roll down a slightly inclined plane for the printer to place another sheet of paper over the type.
>
> Because of Leonardo's studies on the effect of friction this machine is as frictionless as possible, and with a system of weights so arranged as to be perfectly balanced, the operation of this press is almost effortless.
>
> To those who appreciate the beauty of simplicity and compactness in a mechanical contraption the beauty of this press is inescapable and the amazing versatility of the inventor startling in its scope.

A working model of this press is included in the present exhibition of the works of Leonardo. On this same model a short description of its invention and operation was printed during a similar exposition last year in Milan, Italy.

LABORATORY OF THE COMMISSION ON THE STANDARDIZATION OF BIOLOGICAL STAINS

The Philadelphia College of Pharmacy and Science at Philadelphia has been selected as the new location for the laboratory of the Commission on the Standardization of Biological Stains. This laboratory, until recently at the Arlington Experimental Farm (Virginia) of the Bureau of Agricultural Chemistry and Engineering of the U. S. Department of Agriculture, is now working in the department of chemistry through the cooperation of Dr. Louis Gershenfeld, head of the department of bacteriology and hygiene, and Dr. Arthur Osol, director of the chemical laboratories.

Under the direction of Mrs. Anis P. Bradshaw, formerly of Arlington, the purpose of the laboratory is to carry out the chemical analyses necessary for the certification of dyestuffs to be employed as biological stains for bacteria identification and for diagnostic determinations in the United States and in certain Pan-American countries. All dyestuffs employed for biological determinations are tested for dye content and identity. Another important object of the work is the improvement in existing products and the synthesis of new dyes for specific purposes. In addition all certified bacteriological stains are checked as to their suitability in the staining technics in which they are to be used at the Agricultural Experiment Station at Geneva, N. Y. Both the chemical and bacteriological laboratories work in close cooperation and much of the work is verified through bacteriological experimentation by specialists. The establishment of the commission dates back to 1920, when dyestuffs which had been imported from Germany were no longer available. In general the American products at that time were not satisfactory. At the suggestion of the Society of American Bacteriologists and under the auspices of the National Research Council, the laboratory was established under a grant from the Chemical Foundation. During the past two decades the work of the commission has been expanded. It is under the chairmanship of Dr. H. J. Conn, of the New York State Agricultural Experimental Station at Geneva.

The Philadelphia College of Pharmacy and Science recently observed the one hundred and eighteenth commencement since its founding in 1821. At that exercise, Dr. Louis Gershenfeld, under whose auspices the laboratory came to Philadelphia, was awarded the honorary degree of doctor of science.

MEETING OF THE PAN-AMERICAN CONGRESS OF OPHTHALMOLOGY AT CLEVELAND

Plans for a Pan-American Congress of Ophthalmology to be held at Cleveland on October 11 and 12 have been announced. The congress will be sponsored by the American Academy of Ophthalmology and Otolaryngology, an organization of more than 2,500 specialists in diseases of the eye, ear, nose and throat, which will hold its annual convention immediately preceding the Pan-American gathering.

The U. S. Department of State has expressed its interest, and the governments of all the countries of the Western Hemisphere have been invited to send official delegates. It is hoped that the meeting will do much toward bringing about an *entente cordiale* among scientific men of the two Americas, and it is expected that a permanent organization will be effected.

The committee that is developing the congress has the following members: Drs. Harry Gradle, Chicago; Conrad Berens, New York, and Moacyr E. Alvaro, São Paulo, Brazil. The executive secretary of the American Academy of Ophthalmology and Otolaryngology, which will be host to the Latin-American eye specialists, is Dr. William P. Wherry, 1500 Medical Arts Building, Omaha, Nebr.

Under the direction of Dr. Berens, papers in Spanish or Portuguese will be made understandable to English-speaking ophthalmologists by the use of lantern slides projecting a synopsis of each paragraph translated into English. The reverse process will be used with the English papers. Spanish and Portuguese stenographers will be present to record the discussions in the language of the authors.

The congress is open to any ophthalmologist who wishes to register. Non-members of the Academy of Ophthalmology and Otolaryngology may register regardless of attendance at the academy meeting proper. Individual invitations have been sent to about 1,800 members of the ophthalmologic profession in the Latin-American countries, as well as to the national societies of eye specialists and the universities. Individual invitations were not sent to ophthalmologists in the United States and Canada, but official invitations to them are being printed in the various journals of ophthalmology. A fee of $5 has been set for membership in the congress.

CONFERENCE ON APPLIED NUCLEAR PHYSICS

A general conference on Applied Nuclear Physics, sponsored by the American Institute of Physics in cooperation with the Massachusetts Institute of Technology, will be held during the week of October 28 to November 2, at the institute. The rapidly increasing number of applications of methods and apparatus characteristic of nuclear physics in the fields of biology, radiology, chemistry, geology and industrial physics has long emphasized the usefulness of a joint conference between physicists and their colleagues in other fields of science.

The purposes of the conference are to bring together investigators who may be widely separated geographically, and to provide a forum for assembling and correlating present knowledge and difficulties, and for directing attention toward fundamental lines of research which should be the subject of future investigations.

The week's activities will be divided into separate sessions on applications to biology, chemistry, radiology, metallurgy, geology, and to general sessions relating to the production and use of radioactive and stable isotopes, and the protection of workers from radiation. The subjects to be discussed are:

October 28, Techniques and Standards in Terrestrial Radioactivity Measurements; Tracer Studies of Metal Diffusion and Corrosion; Geochemical Applications of Radioactivity; Radiography with Gamma-Rays, X-Rays and Neutrons.

October 29, Radioactive Methods of Geologic Age Determinations; Tracer Techniques in General Chemistry; General Aspects of Cancer Therapy; Geophysical Applications of Nuclear Physics; Tracer Techniques in Analytical Chemistry; Radium and Roentgen Therapy.

October 30, Production of Radioactive and Stable Isotopes and of Penetrating Radiations; Measurement of Radioactive and Stable Isotopes and of Penetrating Radiations.

October 31, Protection of Workers from Biological Effects of Radiation; Synthesis of Organic Substances Containing Tracers; Neutron and Artificial Radioactivity Therapy; Tracer Techniques in Biology.

November 1, Dosage Measurements; Tracer Studies of Plant and Animal Metabolism; Radiobiology; Tracer Studies (continued).

November 2, Tracer Studies (concluded); Contributed Papers.

The daily sessions will consist of short invited papers by leading investigators followed by discussion. Ample time will be allowed between and after regular sessions for personal and informal conferences. While the emphasis will be on the program of invited papers and the discussion of these, provision has also been made for a limited number of ten-minute contributed papers. Five one-hour evening sessions will be held, in each of which an outstanding investigator will summarize the status of the several fields which are joined together by the conference. The evening lectures will be open to the general public.

The committee in charge of the program includes Robley D. Evans, *chairman,* Massachusetts Institute of Technology; Elmer Hutchisson, *secretary,* University of Pittsburgh; Henry A. Barton, American Institute of Physics; Edw. U. Condon, Westinghouse Electric and Manufacturing Company; Lee A. DuBridge, University of Rochester; G. Failla, Memorial Hospital, New York; Clark Goodman, Massachusetts Institute of Technology; Ernest O. Lawrence, University of California; Harold C. Urey, Columbia University.

Letters and inquiries should be addressed to Professor Robley D. Evans, *general chairman,* Conference on Applied Nuclear Physics, Massachusetts Institute of Technology.

RETIRING MEMBERS OF THE FACULTY OF THE OHIO STATE UNIVERSITY

The Ohio State University Monthly reports that five members of the faculty of the Ohio State University retired at the close of the academic year with the title emeritus. They have served for periods ranging from twenty-six to forty-one years.

Those on whom the title was conferred are Dr. William E. Henderson, professor of chemistry; Dr. George Bolling, professor of classical languages; Dr. James E. Hagerty, professor of social administration; Dr. Edwin F. Coddington, professor of civil engineering, and Professor Alonzo Tuttle, of the College of Law.

In recognition of their services, the Board of Trustees adopted the following resolution:

> *Whereas,* Five members of the Ohio State University faculty are retiring from active duty on September 1, 1940, with the well-merited rank of emeritus professors, and
>
> *Whereas,* In their periods of university service ranging from twenty-six to forty-one years they have given unselfishly and devotedly of their time and energy in the classroom and in the laboratory, in important committee responsibilities, and in other areas of the institution's activities and relationships; now, therefore, be it
>
> RESOLVED that this board express the gratitude and appreciation of the Ohio State University to the following five members of the faculty who are soon to relinquish the responsibilities of active membership on the staff.

The citations for Professor Henderson and Professor Coddington are given below:

> DR. WILLIAM E. HENDERSON, *professor of chemistry,* who has distinguished himself in his professional field as a teacher and as an author; who has served since 1899 as a member of the faculty in the department of chemistry, with added responsibilities in the years 1921 to 1927 as dean of the College of Arts, Philosophy and Science, and more recently as a member of the faculty committee to advise with the Board of Trustees on university affairs.
>
> DR. EDWIN F. CODDINGTON, professor of geodetic engineering; an alumnus of our own university who returned to the faculty of his alma mater in 1902 and has served it continuously and with devotion since that time, in the departments of mathematics, mechanics and civil engineering, as well as on the staff of the Engineering Experiment Station; for five years, 1915 to 1920, he was acting dean of the College of Engineering.

RECENT DEATHS

DR. SIGARD ADOLPHUS KNOPF, physician of New York City, formerly professor of phthisiotherapy at the New York Post-Graduate Medical School, died on July 15 at the age of eighty-two years.

Professor Frank George Wren, Walker professor of mathematics, dean of the School of Arts and Sciences of Tufts College, died on July 17 at the age of sixty-six years.

Dr. Harry Augustus Itter, professor of geology at Lafayette College, died on July 14 at the age of forty-one years.

Dr. Matthew Young, lecturer in anatomy at University College, London, died on May 25 at the age of fifty-six years.

The death is announced at the age of ninety years of Dr. Edoardo Maragliano, Senator of Italy, who had been president of the medical faculty and rector of the University of Genoa, and for forty-three years professor of clinical medicine.

SCIENTIFIC NOTES AND NEWS

The Archives of Pathology for July is dedicated to Dr. S. Burt Wolbach, Shattuck professor of pathological anatomy in the Harvard Medical School, pathologist of the Peter Bent Brigham Hospital and of other Boston hospitals. Dr. Walter B. Cannon writes an introduction to this special issue, which contains research articles by many of Dr. Wolbach's present and former students and associates.

Dr. Philip E. Smith, professor of anatomy at the College of Physicians and Surgeons of Columbia University, was recently awarded the Charles Mickle Fellowship of the University of Toronto in recognition of his work on the pituitary gland. The fellow receives the annual income from an endowment fund of $25,000 provided under a bequest by the late Dr. W. J. Mickle. It is awarded annually "to that member of the medical profession who is considered by the council of the Faculty of Medicine of the University of Toronto to have done most during the preceding ten years to advance sound knowledge of a practical kind in medical art or science."

Dr. D. C. Warren, of the poultry department of the Kansas State College at Manhattan, was presented with the $1,000 Borden Award "for outstanding research work in poultry husbandry in the United States and Canada during the past seven years," at the thirty-second annual meeting of the Poultry Science Association, which was held last month at Cornell University.

Dr. Karl B. McEachron, director of the "Lightning Laboratory" of the General Electric Company in Schenectady, N. Y., received the award of the B. F. Goodrich Company "for distinguished public service" in special ceremonies at the World's Fair in commemoration of the hundred and eighty-fifth anniversary of Benjamin Franklin's kite experiment with lightning.

Dr. Warren H. Lewis, who is retiring as research associate in the department of embryology of the Carnegie Institution of Washington and professor of physiological anatomy in the Johns Hopkins University, has been appointed a member of the Wistar Institute of Anatomy and Biology in Philadelphia, as of July the first. The Carnegie Institution is maintaining at the Wistar Institute the program of Mrs. Warren H. (Margaret A. R.) Lewis, research associate in the institution, on the same basis as in past years at the laboratories of the Carnegie Institution in Baltimore, and the International Cancer Research Foundation is continuing to assist the investigations of Dr. and Mrs. Lewis by a grant for research assistance as in past years.

Dr. Karl K. Darrow, research physicist at the Bell Telephone Laboratories, has been appointed visiting professor of physics on the William Allan Neilson Foundation at Smith College for the second semester 1940–41. He will be the fifth scholar to occupy the chair, which was founded in 1927 as a gift to William Allan Neilson in recognition of his completion of ten years service as third president of Smith College. The foundation was permanently endowed by alumnae, undergraduates and friends of the college in June, 1935. Dr. Darrow will present a series of lectures in the field of atomic physics suitable for members of the department and for advanced students, seniors and graduate students of other departments. He will also contribute to a seminar in nuclear physics.

Recent promotions at the College of Medicine of the State University of Iowa include the following: Dr. Erwin G. Gross, chairman of the department of pharmacology; Dr. Walter R. Ingram, professor and head of the department of anatomy, neuroanatomy, histology and embryology; Dr. Rubin Flocks, associate professor of urology, and Dr. Irving H. Borts, assistant professor of hygiene and preventive medicine.

Dr. Carl C. Pfeiffer, formerly instructor in pharmacology at the University of Chicago, has been appointed associate professor of pharmacology at Wayne University Medical School.

The Rev. Charles A. Berger, of the department of biology at Woodstock College, Md., has become head of the department of biology at Fordham University. Dr. George Antonoff, of the Universities of Manchester and Cambridge, has been appointed visiting professor of chemistry.

Professor N. H. Manderfield, head of the department of metallurgy and mineral dressing of the Michigan College of Mining and Technology, Houghton, who has worked at the industrial applications of the subject and in mineral dressing curricula, has been made chairman of a newly established department of mineral dressing. Walter Keck has been promoted from an assistant to an associate professorship of mineral dressing.

Dr. Arthur S. Adams, assistant to the president of the Colorado School of Mines, has been appointed assistant to the dean of the College of Engineering of Cornell University. He will be an addition to the present administrative staff of the college with functions in the general area of academic development.

Allyn Ryerson Jennings, since 1936 general superintendent of the Department of Parks of New York City, was appointed general director of the New York Zoological Park and of the New York Aquarium at a meeting on July 15 of the board of trustees of the society. He succeeds Dr. W. Reid Blair, who retired on May 1, having reached the age of sixty-five years. He had been connected with the park for thirty-eight years, for fourteen years as director. Harry Sweeney, Jr., of the Park Department, who for the last two years has directed the New York City exhibit at the World's Fair, was appointed assistant general director. George E. Spargo, assistant park commissioner, will succeed Mr. Jennings as ranking officer of the Park Department.

James Stokley, who had been a member of Science Service until 1931, when he accepted a position with the Franklin Institute, Philadelphia, later becoming director of the Buhl Planetarium, Pittsburgh, has rejoined the Service. He will take the place of Robert D. Potter, staff writer in the physical sciences, who resigned on June 1 to become science editor of the *American Weekly*.

James H. Critchett, vice-president of the Electro Metallurgical Company and of the Union Carbide and Carbon Research Laboratories, Inc., New York, past president of the American Electrochemical Society, has become a member of the Division of Chemistry and Chemical Technology of the National Research Council.

Dr. Clarence Orion Cheney, professor of clinical psychiatry at the Cornell University Medical College, has been appointed a member of the medical board of the New York Hospital.

Dr. Friedrich W. Klemperer, of the Harvard University Medical School, has been appointed editor of the section on Biochemical Techniques and Apparatus of *Biological Abstracts*, in succession to the late Dr. Glenn E. Cullen.

Lincoln T. Work, assistant professor of chemical engineering at Columbia University, has been appointed director of research and development of the Metal and Thermite Corporation, New York, N. Y.

Dr. T. G. Yuncker, professor of botany at DePauw University, has returned to the United States after a year's absence in the south seas under the auspices of Bishop Museum at Honolulu. Collections were made in the Manua group of the Samoan Islands and also on the island of Niue, which had not previously been visited by botanists.

Dr. A. G. Plakidas, associate plant pathologist at the Louisiana Agricultural Experiment Station, has a year's leave of absence, beginning on September 1, for special study at Cornell University under a grant from the General Education Board.

The Norman Lockyer lecture of the British Association was given at Hull on June 24 by Professor W. L. Bragg.

A Conference on Science, Philosophy and Religion in their Relation to the Democratic Way of Life will be held at the Jewish Theological Seminary of America, New York City, on September 9, 10 and 11. Dr. Edwin G. Conklin, professor of biology emeritus at Princeton University, executive vice-president of the American Philosophical Society, will speak before the division of the Natural Sciences, and a paper by Dr. Albert Einstein, Institute for Advanced Study at Princeton, N. J., will be presented by title.

A Council of Scientific Societies of Western New York, composed of two representatives from each participating society or group, has been formed to stimulate and to form a central clearing house for scientific activities in the Niagara Frontier. It plans to bring together individual investigators and to encourage national societies to visit Buffalo; to act as adviser to the schools, museums, local groups and individuals; to encourage local scientific exhibitions and demonstrations; to further publication of research and to assemble and maintain a bibliography of scientific publications concerning the area or by residents of the area. Irving G. Reimann is president of the council, A. H. Bennett and Dr. Ellen M. Nicholson are vice-presidents; Miss Kathryn Alden Schenck is secretary, and Professor W. P. Alexander treasurer.

The U. S. Civil Service Commission has announced examinations to fill engineering positions in the government in various specialized fields. Salaries range from $2,600 to $4,600 a year, less a retirement deduction of 3½ per cent. Applications should be filed with the Commission's Washington office not later than August 5. There are also announced examinations to secure explosives engineers for the Federal service.

The examination covers five grades, with salaries ranging from $2,600 to $5,600 a year, less the retirement deduction. Applications should be on file with the Commission's Washington office on August 19. Further information regarding these examinations may be obtained from the Secretary of the Board of U. S. Civil Service Examiners at any first- or second-class post office, or from the U. S. Civil Service Commission, Washington, D. C.

ALPHA EPSILON DELTA, the national honorary pre-medical fraternity, recently installed a new chapter at the Ohio State University. On May 31 Dr. Emmett B. Carmichael, of the School of Medicine of the University of Alabama, who is executive councilor of the fraternity, installed thirty students and four members of the faculty of the charter group as the Ohio Alpha Chapter. Members of the faculty initiated as honorary members of the fraternity were: Dr. H. E. Setterfield, associate professor of anatomy in the College of Medicine; Dr. Alva W. Smith, associate professor of physics; Dr. Raymond J. Seymour, professor of physiology in the College of Medicine, and Dr. Joseph N. Miller, *instructor in parasitology*.

THE Desert Laboratory at Tucson, Arizona, has been turned over by the Carnegie Institution of Washington, D. C., to the Forest Service. The Desert Laboratory was concerned with the study of arid and semi-arid regions which comprise almost a fourth of the area of continental United States.

A FELLOWSHIP has been established in the National Research Council for the year 1940–41 through funds provided by the RCA Manufacturing Company, Inc., for the purpose of investigating biological problems such as the structure of viruses, bacteria and other micro-organisms, and tissue cells with the electron microscope. It will carry a stipend of $3,000 and will be known as the RCA Fellowship, to be awarded by the following committee of the National Research Council, who will act also in an advisory capacity to the fellow: Stuart Mudd, *chairman*, M. Demerec, Caryl P. Haskins, J. H. Kempton, C. W. Metz, W. M. Stanley and V. K. Zworykin. The work will be carried on in the Research Laboratories of the RCA in Camden, N. J. In considering candidates, preference will be given to versatile young men of United States citizenship, who have sound training in micro-biology, a doctor's degree and a record of original work. Applications, in quadruplicate, on forms which will be supplied on request, together with supporting documents, should be submitted on or before August 15 to the Division of Biology and Agriculture, National Research Council, 2101 Constitution Avenue, Washington, D. C.

APPROPRIATIONS of the Federal Government to the various states for improvement of game conditions amount to the sum of $2,300,000. Michigan received the largest amount, $127,322; Texas was second with $120,297, and New York third with $120,163. Participating states are required to contribute 25 per cent. of the cost of any project. The total sum available in aid of wild life for the present year is $3,066,667.

DISCUSSION

THE NATURE OF THE INTERMOLECULAR FORCES OPERATIVE IN BIOLOGICAL PROCESSES

IN recent papers P. Jordan[1] has advanced the idea that there exists a quantum-mechanical stabilizing interaction, operating preferentially between identical or nearly identical molecules or parts of molecules, which is of great importance for biological processes; in particular, he has suggested that this interaction might be able to influence the process of biological molecular synthesis in such a way that replicas of molecules present in the cell are formed. He has used the idea in connection with suggested explanations of the reproduction of genes, the growth of bacteriophage, the formation of antibodies, and other biological phenomena. The novelty in Jordan's work lies in his suggestion that the well-known quantum-mechanical resonance phenomenon would lead to attraction between molecules containing identical groups and to autocatalytic reproduction of molecules. Jordan himself expressed some doubt as to whether resonance attraction could really be operative in this way; after studying the question, we have reached the conclusion that the theory can not be applied in the ways indicated by him, and that his explanations of biological phenomena on this basis can not be accepted. In this note we wish to state our objections to Jordan's hypothesis and to formulate briefly our view of the present status of the chemical problems involved in these phenomena. We shall not discuss here Jordan's biological arguments for the occurrence of autocatalytic reactions, as *distinct* from the arguments concerning their mechanism.

Let us consider two identical molecules or parts of molecules, A and B, which interact with each other, the interaction being perhaps the electrostatic interaction of electric dipoles in the molecules, as considered by Jordan. If both molecules are in their lowest states the interaction is normal. If, however, one is in its lowest state and the other in an excited state there occurs a resonance phenomenon; the wave function is either the symmetric or the antisymmetric combination of two functions, one representing molecule A normal and molecule B excited, and the other the reverse. For one of these symmetry types there is a resonance stabilization and attraction between the two molecules, and for the other a resonance repulsion.

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[1] P. Jordan, *Phys. Zeits.*, 39: 711, 1938; *Zeits. f. Phys.*, 113: 431, 1939; *Fundam. Radiol.*, 5: 43, 1939; *Zeits. f. Immun. forsch. u. exp. Ther.*, 97: 330, 1940.

It is this resonance stabilization between identical molecules which Jordan invokes as the cause of his postulated process of synthesis of molecules similar to a molecule present in the cell. His argument requires, of course, that the stabilization occur only between identical molecules, or, at any rate, between molecules which differ only slightly. Moreover, since the phenomenon does not occur for two molecules in their lowest energy states, he assumes that there exist excited energy states differing from the lowest state by a small amount of energy ($\sim kT$), so that thermal excitation raises the molecules to these excited states.

Now let us examine Jordan's argument. In addition to those objections which the author himself has pointed out we may advance the following ones.

(1) The resonance stabilization between two identical molecules is equal to the resonance integral $H'_{n'_A n''_B, n''_A n'_B}$ (here n' and n'' are quantum numbers for the states involved in the resonance), which to be effective in determining the behavior of the system must be at least of the order of kT in magnitude. But ***under the assumed circumstances the resonance between unlike molecules would be nearly as great as that between like molecules.***[2] If the two molecules A and B are unlike, but have excited states with nearly the same energy difference ($\sim kT$) from their normal states, then the resonance stabilization will be equal to the resonance integral; even if the energy values of the excited states for the two molecules differed by as much as one half the resonance integral ($\sim {}^1/_2 kT$), the resonance stabilization would still be about three *quarters as great as for identical molecules.*[3]

(2) For large molecules in solution, such as protein molecules, the complexity of the molecules and the perturbing influence of the environment would be such as to make the energy spectrum of a molecule effectively a continuum, and would wipe out the distinction between unlike and like molecules.

(3) The reasonance stabilization is equal to the resonance integral, and must be of magnitude kT or greater to be effective; *i.e.,* it must be as great as the energy difference between ground state and excited state. On the other hand, the theory requires the excited state which is involved to be non-degenerate. But by definition a "non-degenerate" state in perturbation problems is *one for which the energy differences* with all other states are greater than the resonance integral; hence Jordan's argument is inconsistent.

Summing up, then, we find that under the conditions of excitation and perturbation prevailing in aqueous solutions the resonance interaction could not cause a specific attraction between like molecules and therefore could not be effective in bringing about autocatalytic reactions.

It is our opinion that the processes of synthesis and folding of highly complex molecules in the living cell involve, in addition to covalent-bond formation, only the intermolecular interactions of van der Waals attraction and repulsion, electrostatic interactions, hydrogen-bond formation, etc., which are now rather well understood. These interactions are such as to give stability to a system of two molecules with *complementary* structures in juxtaposition, rather than of two molecules with necessarily identical structures; we accordingly feel that complementariness should be given primary consideration in the discussion of the specific attraction between molecules and the enzymatic *synthesis of molecules.*

A general argument regarding complementariness may be given. Attractive forces between molecules vary inversely with a power of the distance, and maximum stability of a complex is achieved by bringing the molecules as close together as possible, in such a way that positively charged groups are brought near to negatively charged groups, electric dipoles are brought into suitable mutual orientations, etc. The minimum distances of approach of atoms are determined by their repulsive potentials, which may be expressed in terms of van der Waals radii; in order to achieve the maximum stability, the two molecules must have complementary surfaces, like die and coin, and also a complementary distribution of active groups.

The case might occur in which the two complementary structures happened to be identical; however, in this case also the stability of the complex of two molecules would be due to their complementariness rather than their identity. When speculating about possible mechanisms of autocatalysis it would therefore seem to be most rational from the point of view of the structural chemist to analyze the conditions *under which complementariness and identity might* coincide.

From the biological side it would seem most rational to postulate the possibility of both processes; *viz.,* formation of complementary non-identical structures and formation of complementary identical structures, and to proceed by analyzing experimental data for clear-cut evidence as to their occurrence.

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[2] This is found to be so by evaluating the roots of the secular equation corresponding to the perturbation.

[3] The relation between the amount of resonance stabilization and the energy difference of the resonating states is given, for example, by L. Pauling, "The Nature of the Chemical Bond," p. 18. Cornell University Press, Ithaca, N. Y. 1940.

LINUS PAULING

GATES AND CRELLIN LABORATORIES
OF CHEMISTRY,
CALIFORNIA INSTITUTE OF TECHNOLOGY

MAX DELBRÜCK

PHYSICS DEPARTMENT,
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A NEW CALCULATION OF THE C=C BOND STRENGTH AND OF CERTAIN RESONANCE ENERGIES[1]

IN the current table of bond energies[2] used for interrelating the structures of molecules and thermal data relating to them and for predicting resonance energies, a strength of 100 is assigned to the $C=C$ bond. (Bond strengths are given in kcal./mole units, bond lengths in Ångstroms.) This value appears to be at variance with the data relating to ethylene and allene.

The heat of combustion of gaseous ethylene[3] is 337.28. The heat of combustion of gaseous methane[3] is 212.79. Writing 4d for the amount by which the ethylene $C-H$ bonds exceed the methane bonds in strength, we deduce that the $C=C$ bond in ethylene has the strength 94.29-4d. Using the heat of hydrogenation[4] of ethylene 32.58 and the heat of combustion of ethane[3] 372.81, it follows that this bond strength is 94.51-4d. Correspondingly, from the heat of hydrogenation[4] of allene 71.28 and the heat of combustion of gaseous propane[3] 530.57, it follows that the strength of the $C=C$ bond in allene is 92.57-2d′, where d′ is the amount by which each allene $C-H$ bond exceeds the methane bond in strength. The $C-H$ bond length[5] in ethylene and in allene is quoted at 1.087, which is smaller than the $C-H$ bond length[2] in methane, quoted at 1.093. Hence it must be presumed that d and d′ are positive and that the $C=C$ bond strengths in ethylene and allene are less than 94.29 and 92.57, respectively.

This considerable modification in the $C=C$ bond strength implies a considerable modification in the resonance energies of benzene, naphthalene, etc., as at present defined.[2] For example, the resonance energy of benzene, defined as $E-E'$, where E is the heat of formation and E′ the sum of the strengths of $3C-C+3C=C+6C-H$, is now increased by at least 17: naphthalene correspondingly, whose E′ function includes $5C=C$ bonds, has its resonance energy increased by at least 28, and for anthracene and phenanthrene the increase is at least 39. Other molecules have their resonance energies increased at least by the following amounts: pyridine, furan, pyrrole and thiophene 11, quinoline and indole, 22, carbazole 34, and so on.

DOROTHY WRINCH

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[1] Contribution from the Chemical Laboratory of the Johns Hopkins University, Baltimore, Md.

[2] Pauling, "Nature of the Chemical Bond," 1939, 1940.

[3] Rossini, *Ind. and Eng. Chem.*, 29: 1424, 1937.

[4] Kistiakowsky *et al.*, *Jour. Am. Chem. Soc.*, 58: 137, 1936.

[5] Eyster, *Jour. Chem. Phys.*, 6: 580, 1938.

AVOIDING OBVIOUS RESIDUE FROM NICOTINE-BENTONITE SPRAYS[1]

BECAUSE of reports, from many places, of the unsatisfactory obviously heavy residue on fruit and foliage resulting from the use of nicotine-bentonite combinations, we wish again to call attention to our experience.

Using Wyo-Jel bentonite obtained from the Wyodak Chemical Company, Chicago, Illinois, we proceeded first to wet weighed portions of bentonite, using a mechanical stirrer, before adding the nicotine. The spray resulting from this method left a very marked residue on fruit and foliage which was quite obvious from some distance. The trees gave the appearance of vegetation which has been covered with dust along a very dusty dirt road. McCrory and Vinson[2] described in 1938 a method of mixing nicotine sulfate (Black Leaf 40) and bentonite which gave *no obvious* residue when the material was used as a spray. The method consists in adding a known quantity of Black Leaf 40 to a weighed portion of *dry* bentonite. The materials are mixed *in the dry condition* with a stick or other suitable stirrer. The mixture is then allowed to stand in a tightly closed container over night. By the following morning the lumps crumble and all is passed through an eighteen-mesh screen. The screened combination disperses readily in the spray tank to form a stable suspension. Such a spray gives *no obvious* residue on fruit or foliage. Eight sprays of such a preparation in 1938 and six in 1939 resulted in *no obvious* residue. Certainly there was no suggestion from the appearance of the fruit at harvest that any kind of cleaning was necessary or desirable.

Control of codling moth by such a nicotine-bentonite combination gave results which compared very favorably with that obtained by the standard spray of lead arsenate. About eighty-seven thousand apples were counted from the sprayed plots in 1939. The percentage of clean fruit from plots sprayed with the nicotine-bentonite combinations was 92.4 and the percentage of clean fruit from the lead arsenate plot was 91.3. The number of entries was slightly reduced and the number of stings was greatly reduced under those for the lead arsenate.

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[1] Contribution from the Department of Horticulture, Missouri Agricultural Experiment Station Journal Series No. 634.

[2] S. A. McCrory and C. G. Vinson, *Mo. Agr. Exp. Sta. Res. Bull. No.* 292, 1938.

SOME RESULTS OF COLCHICINE INJECTIONS

INJECTIONS (Peter Gray method) of 0.02 cc of a 0.0001 per cent. solution of colchicine used on developing 24-hour chick embryos have shown the following results: (1) four of 20 injected eggs hatched, two males and two females; the hatched chicks have now reached the age of 9½ months, except for one hen which has been sacrificed for histological studies. (2) The combs and wattles in both sexes are abnormally large, approximately of twice the size of normal chickens. (3) Two of the tail fathers of the roosters have become greatly elongated. (4) The hen kept in the cage with one of the roosters lays non-hatching eggs at the rate of one every two or three days.

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SCIENTIFIC BOOKS

AVIATION MEDICINE

Principles and Practice of Aviation Medicine. By HARRY G. ARMSTRONG, B.S., M.D., Captain, Medical Corps, U. S. Army, and director, The Aeromedical Research Laboratory. 496 pp. Baltimore: Williams and Wilkins Company. 1939. $6.50.

AVIATION is becoming one of the major factors in history. Gunpowder overthrew the feudal system. Steam created the modern industrial civilization. Electricity and the petroleum motor have profoundly altered the conditions of modern life. But not one of these factors has ever, within so brief a period, exhibited a greater power to influence the course of history than has aviation. Even as these words are written, sea power, long the dominant force in international affairs, is challenged by power in the air.

For efficiency and safety in the use of any great discovery or invention two factors are required: perfection of matériel and selection and training of personnel—the machine and the mechanic—the gun and the man behind it. The railroad and the steamboat in their early days caused numerous fatalities, but these means of travel have gradually been improved until now a railroad train and a steamship are almost havens of safety. Modern industry has involved many new health hazards—chiefly those of industrial poisoning—which medical science is now striving to control. In these illustrations the requirements of safety apply more to improvements in the machines and industrial methods than to the human element. Careful selection of personnel is rarely needed. In aviation, however, the balance is the other way. Even when the machines of flight were in their crude beginnings, the crashes and fatalities due to the human element were many times more frequent than those due to mechanical defects and failures. And, as experience has accumulated, the advances in aerial engineering have greatly diminished the hazards of the matériel of flight, while the hazards involved in the personnel—those inherent in the nature of the aviator—have been relatively far less effectively counteracted. Hence the need for the new science of aviation medicine—the physiology of man in the air.

Man is not naturally an aerial animal. In his construction there are, indeed, finely designed instruments, notably the vestibular apparatus and semicircular canals of the ear, which serve his cousins the monkeys admirably in controlling the muscular coordination of long swings and leaps from the limbs of one tree to another. But in the monkey, as in the tumbler of the gymnasium and the trapeze performer of the circus, the individual himself makes the initial movement, which the organ of equilibrium enables him an instant later to meet with a counteracting movement. Not so the aviator. If a movement of the airplane, in which he is passive, swings him in one direction, the stimulus to the inner ear, instead of inducing a righting reaction, may induce a so-called "forced movement," which, instead of leading to recovery of equilibrium, may hurl the plane and himself to destruction.

In the book here under review the chapters (XIV and XV) dealing with "aerial equilibration and orientation" and with "air sickness" have on this account the greatest general interest. It is clearly shown that the two functions of the ear—equilibrium and hearing—are entirely distinct. "Man on the ground maintains himself and orients himself in relation to his environment by means of sensory impressions from his eyes, vestibular apparatus, deep sensibility (muscle, joint and tendon sense), viscera and skin." In the air even vision, the most important of the senses, becomes inaccurate. As the height above the ground increases, the tilt of the plane becomes increasingly difficult to judge. In "blind flight" and at great altitude the pilot must adjust the level of his plane by an artificial horizon—a gyroscope; and must often act directly against what his sensations dictate. The senses of equilibrium and sight are both misleading, and "the messages sent to the brain are false." More reliable, perhaps, are the somatic senses which enable the pilot to "fly by the seat of his pants."

"Airsickness" is essentially the same disorder as seasickness. Persons susceptible to one are susceptible to the other, but no ship on the sea ever tossed and pitched and rolled its crew and passengers as does an airplane in "stunting" or in "bumpy" air. But why the vestibular apparatus induces this misery is no clearer in relation to airsickness than to seasickness.

Wholly distinct are the effects of anoxia: the condition induced by the decreased pressure of oxygen at great altitudes. As a name for this condition the author adopts the term "altitude sickness." He shows that it is essentially the same as the "mountain sickness" which has been the object of so much interest to physiologists from the studies of Paul Bert down to the present time. Like the "mountain sickness" of the alpinist the "altitude sickness" of the aviator occurs in two forms; the acute form in which oxygen deficiency for a brief period abolishes muscular coordination and control and even consciousness, and the chronic form resulting from repeated subacute exposures and resembling the "staleness" of the over-trained athlete.

Under the term "aeroembolism" a condition is postulated for aviators in rapid ascents to extreme altitudes essentially like the caisson disease, which is the result of too rapid decompression after work under compressed air in deep diving and subaqueous tunneling. In how far such effects can occur at the altitudes now commonly attainable is still uncertain; but if the stratosphere is to be invaded this hazard, as well as that of "altitude sickness," will have to be met. It will require that the air pressure in the cabin of the plane shall be kept up at least to that of an altitude of 10,000 feet.

Excellent discussions are given of the requirements for the aviator in respect to his eyes, ears, throat, lungs, heart, nervous system and his neuropsychic character. The care that must be taken of his health, physical and mental, equals or exceeds that for the athlete in strict training. Aviation is a profession that makes such demands on both body and mind—particularly the mind—as no other calling has ever made before.

With these considerations before us it needs no argument to establish the enormous importance of aviation medicine. Without this new science there can be no safe commercial aviation and no efficient military aviation; and without an efficient aviation corps no nation can now be immune from attack. This book is the first in its field in America, and is therefore a contribution of great importance. It is encyclopedic in scope, and for the most part accurate in details. Only on two topics, which happen to fall within the reviewer's competence, has it gone astray. They are the so-called "chronic carbon monoxide asphyxia" (pp. 174–75), and the history of the initial investigations in America on pilot fitness (pp. 10 and 34).

As regards carbon monoxide the curve quoted for the blood concentration is that for equilibrium: its values would be attained only after infinite time. The curve that would express the concentrations in the blood after finite periods of exposure would have ordinates only about half as great. Equally misleading are the statements quoted in regard to so-called "chronic carbon monoxide poisoning." They are taken from one of the numerous clinical writers who, knowing next to nothing about carbon monoxide asphyxia, find it convenient to diagnose their neurotic and hypochondriacal, but quite unexposed, patients as suffering from this alleged chronic disorder. Further investigation of this topic is important in connection with aviation; for, as the author recognizes, any appreciable amount of carbon monoxide in the blood adds to the strain of low oxygen and the resulting "altitude sickness."

The author's failure to do justice to the initial American investigations on "pilot fitness" arises from his having entirely overlooked the papers in which they were first reported.[1] Accordingly, he credits to European sources ideas and discoveries that were really American. He makes such statements as that "The Flack [British] bag was the prototype of the first rebreathing apparatus developed in the [American] Medical Research Laboratory." Actually the reviewer had been using such an apparatus for the laboratory instruction of students for several years before the United States entered the war. During those years two men of outstanding scientific ability, Edward C. Schneider and James L. Whitney, had carried on investigations in my laboratory. Accordingly, when I was asked to organize the laboratory and plan the research work on pilot fitness, I centered it on the so-called "rebreather" as the simplest means of imitating altitude, and called Schneider and Whitney into the aviation service. Their work with the "rebreather" marked the beginning of thorough scientific study anywhere on the capacity of pilots to withstand low oxygen. We got little or nothing from foreign sources for the very good reason that at that time there was almost nothing to get. How clear is the case for American priority in this field is demonstrated by the recent investigations of Krogh and Christensen[2] in this field which they recognize to have developed from this pioneer American work.

The format and typography of the book are of the high grade that we have learned to expect from its publishers.

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[1] *Journal* of the American Medical Association, 26: 1382–1400, October 26, 1918.

[2] *Skand. Arch. Physiol.*, 73: 17 and 145, 1936.

SOCIETIES AND MEETINGS

THE ACADEMY CONFERENCE[1]

THE Academy Conference held its thirteenth annual session in the Deshler-Wallick Hotel at Columbus, Ohio, on the afternoon of December 27, 1939.

The conference is composed of (1) representatives named for membership in the council of the American Association for the Advancement of Science by the academies and (2) members of the executive committee of the association. Each affiliated academy names one representative to be a member of the council of the association and that representative is *ex-officio* a member of the Academy Conference. In addition the Academy Conference welcomes the attendance of anyone interested in the interrelationships of the academies and the association. The object is to promote cooperation among the affiliated academies and between them and the association. The officers consist of a chairman, a vice-chairman and a secretary. A vice-chairman is elected at each annual meeting, and he in turn becomes the chairman the succeeding year.

Those present included:

Members of the Executive Committee of the American Association for the Advancement of Science:

- J. McKeen Cattell, Garrison, N. Y.
- Otis W. Caldwell, Boyce Thompson Institute, Yonkers, N. Y.
- Burton E. Livingston, Johns Hopkins University, Baltimore, Md.

Representatives from the Affiliated Academies:

- Alabama Academy of Science
  - J. H. Coulliette, Birmingham Southern College, Birmingham, Ala.
- American Institute of the City of New York
  - Robert T. Pollock, 570 Lexington Ave., New York, N. Y.
- British Columbia Academy of Sciences
  - C. McLean Fraser, University of British Columbia, Vancouver, B. C., Canada
- Colorado-Wyoming Academy of Science
  - F. E. E. Germann, University of Colorado, Boulder, Colo.
- Georgia Academy of Science
  - A. S. Edwards, University of Georgia, Athens, Ga.
- Illinois Academy of Science
  - Lyell J. Thomas, University of Illinois, Urbana, Ill.
- Indiana Academy of Science
  - Howard E. Enders, Purdue University, La Fayette, Ind.
- Iowa Academy of Science
  - Joseph C. Gilman, Iowa State College, Ames, Iowa
- Kansas Academy of Science
  - Roger C. Smith, Kansas State College, Manhattan, Kansas
- Kentucky Academy of Science
  - Austin R. Middleton, University of Louisville, Louisville, Ky.
- Louisiana Academy of Science
  - W. H. Gates, Louisiana State University, Baton Rouge, La.
- Maryland Academy of Science
  - S. Karrer, 2724 N. Charles St., Baltimore, Md.
- Michigan Academy of Science
  - A. Franklin Shull, University of Michigan, Ann Arbor, Mich.
- Minnesota Academy of Science
  - H. K. Wilson, University Farm, St. Paul, Minn.
- Missouri Academy of Science
  - R. T. Dufford, University of Missouri, Columbia, Mo.
- Mississippi Academy of Science
  - Clay Lyle, Mississippi State College, State College, Miss.
- Nebraska Academy of Science
  - W. C. Brenke, University of Nebraska, Lincoln, Nebr.
- New Orleans Academy of Science
  - E. C. Faust, Tulane University School of Medicine, New Orleans, La.
- North Carolina Academy of Science
  - Bert Cunningham, Duke University, Durham, N. Carolina
- Ohio Academy of Science
  - William H. Alexander, Hotel Normandie, Columbus, Ohio
- Pennsylvania Academy of Science
  - V. Earl Light, Lebanon Valley College, Annville, Pa.
- South Carolina Academy of Science
  - G. H. Collings, Clemson College, Clemson, S. Carolina
- Tennessee Academy of Science
  - F. G. Slack, Vanderbilt University, Nashville, Tenn.
- Texas Academy of Science
  - S. W. Bilsing, A. & M. College of Texas, College Station, Texas
- Virginia Academy of Science
  - Edgar C. L. Miller, Medical College of Virginia, Richmond, Va.
- West Virginia Academy of Science
  - P. D. Strausbaugh, West Virginia University, Morgantown, W. Va.
- Wisconsin Academy of Sciences, Arts, and Letters
  - E. M. Gilbert, University of Wisconsin, Madison, Wis.

Guests attending the Academy Conference:

- Karl F. Oerlein, State Teachers College, California, Penna.
- Don O. Baird, Sam Houston State Teachers College, Huntsville, Texas
- H. H. Sheldon, New York University, New York, N. Y.

Dr. Cunningham, the chairman, opened the conference. The secretary stated the procedure which has been followed in past years in the election of officers. It has been the custom to elect at the beginning of the session a vice-chairman who assumes office at the close of the business session of the succeeding meeting. This custom of having the chairman assume the chair in the middle of the session has not been satisfactory. After discussion, it was moved, seconded and voted that the chairman, Dr. Cunningham, preside throughout the present session and that the vice-chairman, Dr. Gilman, serve as chairman during the next session of the conference. A committee was appointed to nominate a vice-chairman. This committee, E. C. L. Miller, Roger Smith and Ernest Carrol Faust, presented the name of P. D. Strausbaugh. The recommendation was unanimously approved.

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[1] Columbus meeting, held in conjunction with the annual meeting of the American Association for the Advancement of Science.

The following program was then presented:

(1) Report of the Subcommittee Appointed to Confer with the American Institute on Problems of the Junior Academy. H. E. Enders, Indiana Academy of Science.

(2) Report on (*a*) The Usefulness of the Academy Research Grants of the A.A.A.S.—in Retrospect and in Prospect; (*b*) On What Basis Should Junior A.A.A.S. Membership Awards be Made. E. C. Faust, New Orleans Academy of Science.

(3) Can the Academy Serve as a Unifying Agent for the Various Scientific Organizations of the State? P. D. Strausbaugh, West Virginia Academy of Science.

(4) The Organization of a State Academy of Science. J. C. Gilman, Iowa Academy of Science.

The special committee of representatives of the conference chosen at the Richmond session in 1938 to consider the relationship between the Junior Academy and the American Institute of the City of New York met in Indianapolis, Indiana, on February 11, 1939. This committee was composed of Otis W. Caldwell, representing the executive committee of the association; Bert Cunningham (North Carolina Academy); J. C. Gilman (Iowa Academy); E. C. L. Miller (Virginia Academy); H. H. Sheldon, American Institute of the City of New York; Lyell J. Thomas (Illinois Academy), and H. B. Enders (Indiana Academy). Louis A. Astell, of the Junior Academy in Illinois, was invited to meet with the committee. Dr. Miller was chosen chairman and Dr. Enders, secretary. The committee considered:

(1) The Aims, Objectives and Organization of Junior Academies of Science.

(2) Aims of the American Institute.

(3) Possible Cooperative Relations with the American Institute in the Development and Promotion of Junior Academy Clubs.

(4) Unification of Science Club Work through Cooperation.

In order to develop a plan to promote high-school science clubs as independent groups or as units of the State Senior Academies of Science the following motions were passed by the committee.

(1) *In states which have a State Academy of Science and a Junior Academy of Science*, any inquiring science club seeking admission to the "Associated Science Clubs" is to be referred to the Junior Academy of Science of the state in which the club is located, for assignment of its membership.

(2) *In states which have no State Academy of Science* and no organized high-school science clubs, any organization of its science clubs shall bear the name "Associated Science Clubs" rather than the name "Junior Academy of Science."

(3) *In states which have no State Academy of Science* any inquiring high-school science club seeking admission to the "Associated Science Clubs" shall be referred to the particular state of its location for membership and be known as the "Associated Science Clubs of ————" (the state as the geographic unit).

(4) *In any state which has an organized State Academy of Science, but no Junior Academy of Science*, it is advised that if or when ten or more high-school science clubs are organized, the general secretary of the American Association for the Advancement of Science be directed to recommend to the existing State Academy of Science an initial establishment of a Junior Academy of Science.

The committee also recommended a continuing committee be set up by the Academy Conference to promote the interests of science clubs.

E. C. Faust (New Orleans Academy) presented a summary of a study of "The Usefulness of the Academy Research Grants of the American Association for the Advancement of Science in Retrospect and in Prospect."

The selection of a grantee or grantees by the academy appears in most cases to be by special committees or members of the Executive Committee of the Council of the State Academy. The general trend is to grant funds to individuals who otherwise would be seriously handicapped in their research.

An analysis of the types of research projects shows that out of a total of 162 projects, 42 were undertaken in physical sciences, 112 in biological sciences and 8 in social and applied sciences. One half of the grantees in the biological sciences undertook problems in the field of natural history and taxonomy.

One third of the money was expended for materials and equipment: some for travel and field expenses and collection of material away from the place where the investigation was being conducted, some for photographs and illustrations; some for technical assistants and statistical aid, and a small percentage for library facilities. More than one third of all the grantees have not furnished information as to the use of the money. Between 1935 and November, 1939, there were 178 grants from funds made available by the American Association for the Advancement of Science. In 1936, 44 per cent. of the grantees published at least one paper each, resulting from the utilization of the funds made by the grants. In 1937 approximately the same number of papers were published by grantees. In 1938 approximately 40 per cent. of the grantees published the results of their investigation. In 1939 up to November 1, 227 of the grantees had already published as a result of the 1939 grants.

The following conclusions have resulted from this inquiry:

(1) The grant is usually made by a special committee responsible either to the academy as a whole or to the executive group of the academy.

(2) Approximately three fourths of all the grants have been made to persons working in the group of biological sciences, and of this number more than one half have selected research problems in the field of natural history and taxonomy. This might suggest that grantees either may not have modern points of view or may not be scientifically prepared to undertake research in more dynamic aspects of their subjects. Research grant committees of the academies should make serious study of the type of problem for which the grant is requested, so that the academies and the association may contribute to productive research.

(3) With an increase in the number of grants made each year through the academies, there has apparently been an increase in the publication each year, although some of the publications consist only of preliminary abstracts or progress reports which apparently are not followed within a reasonable time by publication of complete results.

(4) Secretaries of the academies should keep complete and up-to-date information on the development of the grantees' projects. This information should be required from grantees.

Dr. Faust also distributed a mimeographed copy not here included of an analysis of junior membership in the American Association for the Advancement of Science.

P. D. Strausbaugh (West Virginia Academy) presented a paper on "Can the Academy Serve as a Unifying Agent for the Various Organizations of a State, and How May This Be Done?"

In order to ascertain the interest in such a subject in other academies the following questions were submitted to the Academy Conference representatives:

(1) Has your Academy of Science made any attempt to bring the various scientific organizations of the state into affiliation with the academy?

(2) If not, do you think the State Academy should function as such a unifying agency?

(3) In your opinion, how should the academy proceed to effect such an affiliation of the various scientific organizations within the state?

Replies were received from 20 representatives. Seventeen of these expressed positive interest; five reported considerable progress; two were doubtful, and one was not interested.

Five academies have already succeeded to a degree in bringing about an affiliation of a number of organizations.

In Kansas a committee on affiliation was first appointed in 1931. Several meetings of representative groups have been held, and the Kansas Academy intends to carry on this program of affiliation.

The Iowa Academy meets regularly with the Iowa Section of the Mathematical Association of America and the Iowa Section of the American Association of University Professors.

The Colorado-Wyoming Academy has from its beginning been a strong advocate of the idea of the unification of scientific interests. For several years the Colorado-Wyoming Academy has had permanent affiliation with the Colorado-Wyoming Social Science Association and the past year the Colorado Anthropological Society met with the academy.

In Missouri, the state Audubon Society, the Missouri Section of the Mathematical Association of America and the Speech Association of Missouri regularly meets with the Missouri Academy. In addition, the American Association of University Professors and the various local medical associations have met with the Missouri Academy at various times, and a group which belongs to science clubs in the various colleges and junior colleges constitutes a section of the Missouri Academy.

Affiliated with the Texas Academy are 15 senior societies, nine collegiate chapters of the academy and 15 chapters of the junior academy. The affiliated organizations have a conference which is very similar to the academy conference. This conference of affiliated societies consists of the presidents and secretaries of these societies and the academy's representative to the American Association for the Advancement of Science. The conference holds its meetings in conjunction with the annual meetings of the academy.

From the evidence it is concluded that the academy can function as a unifying agent to secure affiliation of other scientific organizations within the state. The desirability of such an affiliation can scarcely be denied. Tactful approach is a necessity if success is to be achieved. The dominant idea must be the greater service through a closer cooperation of all the state organizations concerned with the advancement of scientific interest.

The next paper, "The Organization of an Academy," was read by J. C. Gilman, of the Iowa Academy.

All the academies have one common objective—the advancement of science within their territory. Each academy meets at least once a year and some of them meet more often; some support a publication, some have a library and a few have museums.

Many academies divide their membership into the following classification: honorary fellows, fellows, members. Several academies have junior academies, but few provide a separate classification for college students. The Iowa Academy has instituted a new class, "fellow emeritus," for persons who have been fellows for 25 years and because of retirement are no longer financially able to pay their dues. Life memberships are provided by most academies upon payment of an amount of money which is designed to bring the academy sufficient interest to cover the annual dues.

The secretary is the most important officer in the organization. He should hold his position for a period of years.

The executive committee formulates the policies of the academy, and, therefore, its members should be active in academy work. In most academies the officers constitute the executive committee. Section chairmen in some academies also serve on the executive committee.

Some academies meet as a body, while others are divided into sections, the Missouri Academy having 20 sections, and the other academies a lesser number. The interrelations between the branches of science seem to indicate that a simpler arrangement with opportunity for workers in interrelated fields to get together might be a better method of organization.

Most academies meet once a year, but a few meet more frequently. The time for the spring meeting is becoming more and more a problem because of the fact that many other organizations hold spring meetings. Would it be possible for all the academies to set aside a week or a week-end in which the academies would meet? Such an arrangement would serve their common interests and enable academies in adjoining states to meet together.

In the field of intersociety relationships there are many opportunities. The Academy Conference is a step in the right direction, but it has a long way to go. The Academy Conference enables representatives of the academies to meet and discuss common problems. It is desirable that the representatives of the various academies should be continued in that capacity over a period of years. It requires some time to become familiar with the functions of the Academy Conference. If the academies would give their representatives the power to act on inter-academy matters, it would strengthen this body considerably.

It is desirable that other local scientific organizations be invited to accept the advantages which result from affiliation with the academy. If the academy could be made the rallying point for these groups, both the local societies and the academy would profit from these relationships.

The effective academy is one with an active group of officers and continuing secretary, whose executive committee, made up of those officers and the chairmen of the standing committees, is an alert group which adequately directs the work of the academy, not only its internal affairs but also its relations to the state in which it is situated. Further, it should be closely affiliated with the American Association for the Advancement of Science and with any other scientific bodies of its particular locality. Such a group is a potent guiding force wherever it may be found.

S. W. BILSING

COLLEGE STATION, TEXAS

REPORTS

GRANTS FOR RESEARCH OF THE GEOLOGICAL SOCIETY OF AMERICA

TWENTY-NINE grants in support of special research projects were authorized by the council of the Geological Society of America at the April, 1940, meeting, as follows:

George P. Woollard, fellow, National Research Council, Princeton, New Jersey, is starting a gravimeter traverse which is expected to complete a line from Washington, D. C., to Los Angeles. Data on the Washington to Pittsburgh portion of the traverse are already available. The gravimeter has been made available by the Humble Oil and Refining Company. The study should yield knowledge of the fundamental structure of North America comparable to that relative to the structure of island arcs provided by the work of Meinesz and collaborators. It is a study by gravitational, geological and magnetic methods of the deeper parts of the earth's crust and the relations of anomalies to continental structure. The work will continue throughout the coming summer. $3,000.

W. J. Mead, Massachusetts Institute of Technology. Under the cooperative direction of Professors Mead and Robley Evans the question of the reliability and limitations of the helium method of determining the age of rocks will be investigated. Dr. Clark Goodman will continue in immediate charge of the work. Three large masses of igneous rocks will be sampled for age determinations on their various parts and phases. The ultimate objective of the investigation is the establishment of a reliable means of determining the age of igneous rocks and the development of an absolute time scale for the geologic column. $3,300.

Bruce L. Clark, University of California, Berkeley, received an additional sum for the completion of his studies of the Cretaceous and Tertiary Radiolaria of western North America. $100.

Charles L. Camp, University of California, Berkeley, will continue the compilation of a bibliography of vertebrate paleontology for the period 1934 to 1938. The period 1928 to 1933 has already been covered, and a manuscript awaits publication by the society. The new volume is approximately half finished. $1,500.

Chester Stock, California Institute of Technology, will continue his work on Tertiary fossil fish faunas of the Pacific Coast with the assistance of Dr. Lore R. David. The work is an extension of an earlier project and is expected to complete the study. $1,000.

Norman D. Newell, University of Wisconsin, will devote the latter part of the coming summer to a revisitation of the Wind River Mountains and adjoining ranges in western Wyoming to study the stratigraphy and paleontology of the Dinwoody formation. The purpose of the study is to locate the Permo-Triassic boundary and to study the Permian history of the northern Rockies and adjoining parts of the Cordilleran geosyncline. $350.

John T. Hack, Harvard University, will resume his studies of the genesis of certain circular structures in the Hopi Buttes country of Arizona. Dr. Hack has spent several seasons in the district and has discovered 50 or more of these structures, the average diameter of which is 3,000 feet, and which he believes are explosive vents rather than cauldron subsidences as interpreted by other workers. Four to six weeks will be spent in the field during the coming summer. $200.

John A. Allan, University of Alberta, will spend five weeks on a pack train field survey within the eastern slope of the Canadian Rockies in western Alberta. A number of trips into the area have been made in past years, and with the completion of the project contribution will be made to the knowledge of the Rocky Mountain geosyncline. The geological section will be made between latitudes 52° and 53° in the vicinity of the North Saskatchewan valley and will complete a section extending westward from the front thrust at least as far as the Continental Divide. $700.

Arthur D. Howard, New York University, Washington Square, will continue his study of the pediment gaps of the Sacaton Mountains of Arizona. The pediment gaps are low cols in the divide at the heads of the pediment embayments and they have a possible bearing on the origin of the pediments. To date pediment gaps are the only important features associated with pediments which have not been examined critically in the field. Dr. Howard expects to spend four weeks in the field during the coming summer and thereby round out available information on the origin of pediments. $215.

Frank F. Grout, University of Minnesota, will maintain the laboratory for rock analyses of research grade with the assistance of this additional grant to guarantee continued operation. The laboratory contributes to a great variety of fundamental problems such as the composition of the earth's crust, the differentiation and contamination of magmas, diagenesis of sediments and the processes of metamorphism. The laboratory has been aided since October, 1934, has proven to be of inestimable service to petrologic research and is patronized by a large number of research workers. More than 800 analyses have been made. $2,000.

Vladimir J. Okulitch, University of Toronto, will extend his researches on the American Pleospongia from fields already studied in eastern Canada to include the collections at the United States National Museum and the Museum of Comparative Zoology at Harvard. This work will complete the description of the American representatives of this class heretofore practically unknown and will make the material available for comparison with that already described for Australia, Siberia and Europe. $130.

Max Demorest, Sterling fellow, Yale University, will continue work now in progress on field studies of glacial petrofabrics and laboratory research on the physics and deformation of ice. This work has been supported by two previous grants. During the coming summer Dr. Demorest will spend ten weeks at Mt. Rainier making petrofabric determinations of ice orientation and its relation to the various stress conditions found in the glaciers. He will continue his cold storage laboratory experiments at New Haven during the succeeding academic year and through the summer of 1941. The work at New Haven is also supported by a National Research Council fellowship. $1,000.

A. J. Eardley, University of Michigan, will spend a month in Utah to complete geologic mapping in a study of the physiography and structure of the north-central Wasatch Mountains. He will examine the pre-Pennsylvanian and post-Cambrian stratigraphy for the solution of certain fault problems and will contribute further details on the Laramide and Basin Range deformations. $200.

Lincoln Dryden, Bryn Mawr College, will supervise the sampling and heavy mineral analysis of Triassic sediments of the Atlantic Coastal Plain. Professor Dryden has been working on the heavy minerals of the Piedmont and Coastal Plain for several years and will now extend his studies over to the Triassic sediments. Several hundred samples will be analyzed, and it is hoped that the results will contribute to a knowledge of the source of the Coastal Plain and Triassic sediments and to the drainage problems of the region. $300.

Ray E. Wilcox, University of Wisconsin, will return to the Yellowstone plateau to continue his study of the origin of mixed rhyolite-basalt rocks already investigated on Gardiner River. Dr. Wilcox will investigate the role of assimilation in the production of the mixed rocks, as well as the possible mixing of simultaneous outpourings of true lavas, and hopes to contribute data on the areal relationships between possible co-existing magma chambers. $500.

Francis Birch, Harvard University, received assistance for his research looking to the determination of the velocity of propagation of shear weaves and rigidity of igneous rocks. This is a laboratory research producing pressure and temperature conditions supposed to exist in a 30-km crust. Pressures up to 10,000 kg/cm^2 and temperatures up to 600° C. will be applied simultaneously. The results of the investigation will contribute toward a solution of the fundamental question of the constitution of the upper layers of the earth. The work is a part of the program of researches in experimental geology and geophysics at Harvard under the joint guidance of Professors Daly and Bridgman. $3,600.

Charles S. Denny, Dartmouth College, will study glacial deposits in the Hanover-Canaan area, New Hampshire, with view to determining the manner in which the last ice sheet disappeared from that region. A study will be made of the abundant water-laid glacial deposits and dry stream channels on hillsides apparently formed by ice marginal drainage and will throw light upon the current belief that, in Wisconsin deglaciation, down wastage played the leading part. $225.

Frank M. Carpenter, Harvard University, will spend July and August in Perry County, Oklahoma, collecting from the Wellington formation material containing Permian insects. Dr. Carpenter has studied insects from the nearly contemporaneous Elmo limestone of Kansas, but apparently those faunas existed under very different environmental conditions, for the Oklahoma insects are decidedly different. The project will contribute to knowledge of Permian insects and to general problems of Permian stratigraphy. The American Academy of Arts and Sciences will also support the project. $300.

Margaret F. Boos, University of Denver, will investigate the pegmatite dikes and wall rocks associated with various granite plutons of the Front Range in Colorado, specifically the inclusions and replacement minerals. It may be possible to determine which pegmatite dikes belong to each successive plutonic invasion or to determine the waves of replacement, assuming that the dikes were established by the first mineralization and were later modified by solutions moving along the established avenues. $350.

A. K. Miller, State University of Iowa, received an additional sum to aid in completion of a monograph on Ozarkian and Canadian cephalopods initiated by Drs. Ulrich and Foerste. Drs. Miller and Furnish will rephotograph much of the material to be described in the monograph. $400.

Samuel S. Goldich, Agricultural and Mechanical College of Texas, and Morris A. Elms, San Antonio, Texas, will complete the mapping of the geology of the Buck Hill quadrangle of Brewster County, Texas. This includes part of the Davis Mountains, whose structure and petrology are quite complicated. The grant will be used largely for a petrologic and chemical study of a series of basalt, andesite, trachyte and rhyolite flows which, with intercalated ash beds and conglomerate, aggregate over 1,000 feet in thickness. The chemical and petrographic studies will indicate probable relationships and assist in the solution of the stratigraphic and structural problems. $350.

Stanley S. Ballard and John H. Payne, University of Hawaii, will secure improved analytical equipment to continue periodic analyses of solfataric gases at Kilauea volcano, and have gas-collecting equipment in readiness for the next suitable eruption of Mauna Loa and Kilauea. The grantees are respectively assistant professor of physics and assistant professor of chemistry at the University of Hawaii. The program of research has been under way for over three years with regular monthly analyses since September, 1938. The purpose of the research is to obtain a series of reliable analyses of the gases from a well-established solfatara (the "Sulphur Banks" of Kilauea) and to study the possible correlations between such gases and volcanic activity. $450.

Loris S. Russell, University of Toronto. The stratigraphy of the interior plains of Canada, under study for many seasons and partly described in the literature, will be rounded out during the coming summer by examination of key areas in western Canada not heretofore studied. Following the field work Professor Russell will prepare a general treatise on the stratigraphy of the region. $450.

Earl Ingerson, Geophysical Laboratory, will make a detailed field study of some of the gold-quartz veins of the Mother Lode of California, including mineral orientation, in an effort to obtain new and more definite information about the mode of emplacement of the veins and their subsequent history. It is hoped to contribute to knowledge of mineral orientation in veins of this type and possibly of the motion of solutions and conditions of pressure obtaining at the time of vein filling. Dr. Ingerson will enjoy full cooperation of Dr. Farmin of the Idaho Maryland Mines Corporation. $600.

Alfred R. Loeblich, Jr., and Helen Tappan Loeblich, University of Chicago, will collect and study foraminiferal material from the Lower Cretaceous Washita group of southern Oklahoma and northern Texas. It is proposed to determine the stratigraphic range and areal distribution of the species of Foraminifera and to study their environmental habitats. Phylogenetic relationships of the Washita Foraminifera to the Upper Cretaceous species of this region and to those of similar age in Europe are to be investigated. $250.

Rousseau H. Flower, University of Cincinnati, will visit museums in Ottawa, Washington, Albany, Cambridge, Chicago and Columbus to study collections of Devonian Nautiloidea and to prepare photographs and descriptions for a monographic treatment of these fossils. $500.

Frank M. Anderson, Berkeley, California, will complete his long-continued investigation of the stratigraphic, lithologic and faunistic features of the Upper Cretaceous sequence in California and Oregon. The project carries forward the grantee's general plan of supplying criteria for emending the past views as to the later Mesozoic on the American west coast, including the later Jurassic, the early Cretaceous, and upper Cretaceous. Paleogeographic data will be contributed. $300.

Robert L. Nichols, Tufts College, will (1) complete his studies of the "Aa flow of Lava Butte, Oregon," will (2) study a fissure about twenty miles long from which more than ten flows have been extruded, and will (3) study flows in the Lava Cast forest of Oregon with particular attention to the position and shape of "lava trees." Several weeks have been spent in these areas in the past, and the purposes of the new studies are to determine the velocity of lava flow from the shape of lava trees and flow mechanism of an aa flow. $280.

H. U. Sverdrup, Scripps Institution of Oceanography, will direct an expedition for the geological exploration of the central Gulf of California. The oceanographic vessel, "E. W. Scripps," will be used for a period of eighty days as a base for investigations of the submarine configuration, sedimentation and current dynamics of the sea floor and reconnaissance study of parts of the surrounding coast. The primary purpose of the expedition is to obtain information on the developmental stages of what may be a modern geosyncline. The oceanographic work by Roger Revelle and F. P. Shepard will produce data regarding the environment of deposition of the marine Tertiary, especially the Miocene diatomaceous shales, rate of accumulation of diatomaceous muds, causes of the laminations in them and significance of their organic content as a possible source of petroleum, information on the tectonics of the area with possible data bearing on the southward continuation of the San Andreas fault system, and new information on submarine canyons. The land exploration will be carried out by W. S. W. Kew and C. A. Anderson in virtually unexplored territory difficult of access and of unusual interest. Studies of the marine Tertiary and of the thick interbedded volcanics should yield information on the structure and earlier development of the great depositional basin. $2,500.

G. E. Condra, University of Nebraska, with the assistance of M. K. Elias, will continue the photographing and description of his large collections of Pennsylvanian and Permian Bryozoa in the preparation of monographic reports. Through many years Professor Condra has collected systematically through the Mid-Continent region and in New Mexico, Arizona, Utah, Wyoming and South Dakota. He has collected in Russia and studied the collections in Perm, Moscow, Leningrad, Stockholm, Copenhagen and London. The acquisition of material from the Glass Mountains of Texas and from Greenland has made the Nebraska collection the largest in the world. Work is already three quarters complete and will be continued through the remainder of the year. $1,400.

SPECIAL ARTICLES

THE SUSCEPTIBILITY OF CHICKS TO DIPHTHERIA BACILLI AND TOXIN

In 1884 Loeffler[1] described the effect of introducing virulent diphtheria bacilli into various birds and animals. Guinea pigs and rabbits were found to be especially susceptible. Later workers abundantly confirmed the latter findings of Loeffler, and these two animals were adopted, to the virtual exclusion of all others, in the study of diphtheria. From the work of Behring, Erlich and others upon measurements of toxin and antitoxin, the 250-gram guinea pig became the standard for such purposes and remains so to-day.

Among other tests made by Loeffler were those on several species of birds. Of thirteen finch-like birds or canaries inoculated intramuscularly with different strains of diphtheria bacilli, all died and at autopsy the organisms were found in large numbers in the tissues immediately surrounding the site of inoculation. All but one of eleven pigeons inoculated by various routes also succumbed to the infection. The effect of inoculating chickens ("fowls") intratracheally was less definite, although membrane-formation in some was observed. In 1899 Salter[2] reported that typical diphtheria bacilli were pathogenic for sparrows, finches, yellow-hammers and the thrush, on the basis of a small number of observations. The studies of Loeffler and Salter on birds were apparently never pursued further.

While retesting the pathogenicity of the diphtheria group of organisms for various species of birds and animals, it was noted that 7-day-old chicks regularly succumbed, following subcutaneous or intraperitoneal inoculation of strains of *Corynebacterium diphtheriae* known to be virulent for rabbits. Subsequent studies showed that death of the chicks rarely followed the inoculation of rabbit-avirulent diphtheria bacilli or diphtheroids. Moreover, as little as one guinea-pig-M.L.D. of diphtheria toxin regularly killed the chicks, while a high degree of protection was afforded by a previous injection of diphtheria antitoxin. Brief details of these experiments follow.

The cultures of *C. diphtheriae* were isolated during the course of local and nation-wide surveys, in which over 2,000 strains of diphtheria bacilli[3, 4] were obtained from healthy carriers and persons with diphtheria. All these strains had previously been examined in this laboratory, and tested for virulence by the intracutaneous method in rabbits, developed by Fraser and Weld.[5] Strains referred to in this study will be designated as "virulent" or "avirulent" on the basis of that test. The organisms used in the experiments described in this paper were incubated for 48 hours in infusion-broth; 0.5 cc being the usual dose.

In a preliminary experiment, week-old White Leghorn or Barred Plymouth Rocks were inoculated subcutaneously in the back near the insertion of the right wing with six different strains of virulent organisms, among which were strains of the gravis, mitis and intermediate types. Of eighteen chicks inoculated, all died within 48 hours, regardless of type of organisms or breed of chick used. Six chicks, previously injected intraperitoneally with 100 units of diphtheria antitoxin, when inoculated with the same six virulent cultures, survived with no evident illness. Likewise, four chicks inoculated with four different strains of avirulent *C. diphtheriae* remained well.

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[1] F. Loeffler, *Mitth. a. d. k. Gsndhtsamte.*, 2: 421–99, 1884.

[2] A. Salter, *Trans. Jenner Inst. Prev. Med.*, London, 2 s: 113, 1899.

[3] W. H. Frost, M. Frobisher, Jr., V. A. Van Volkenburgh and M. Levin, *Am. Jour. Hygiene*, 24: 568–586, 1936.

[4] M. Frobisher, Jr., *Supplement to Am. Jour. Pub. Health*, 30: 28–35, No. 3, 1940.

[5] D. T. Fraser and C. B. Weld, *Trans. Roy. Soc. Canada*, (Sect. V) 20: 343, 1926.

In another experiment with seven-day-old White Leghorn chicks, the following results were obtained: (1) Each of twelve strains of virulent organisms was inoculated subcutaneously in one chick; all twelve chicks died within 24 hours. (2) Twelve chicks, injected intraperitoneally with 200 units of antitoxin two hours previously, were inoculated subcutaneously with the same twelve strains; all twelve chicks remained well for two weeks or longer. (3) Of twelve chicks inoculated with twelve different strains of avirulent *C. diphtheriae,* all but one remained well for two weeks. (4) Of ten chicks inoculated with ten different cultures of diphtheroids, all remained well.

The protocol of a similar experiment with strains other than those mentioned above is shown in Table 1.

TABLE 1

EFFECT OF VARIOUS STRAINS OF CORYNEBACTERIA IN CHICKS

Organism	Result of virulence test in rabbit	Strains	Chicks	Dead	Paralyzed	No visible reaction
C. diphtheriae (with antitoxin)	Positive	10	20	4†	0	16
C. diphtheriae (no antitoxin)	Positive	10	20	19	1	0
C. diphtheriae	Negative	10	20	1*	0	19
C. xerosis	Negative	10	20	1	0	19
C. pseudodiphtheriticum	Negative	10	20	0	0	20

† The other chick of these pairs, in each instance, survived with no visible illness.
* Only after 5 days; no paralysis observed.

Two White Leghorn chicks were inoculated with each strain. The results are essentially the same as those obtained in the previous experiments.

Altogether, of fifty unprotected chicks injected with 35 different strains of rabbit-virulent *C. diphtheriae,* only one survived, and this after a severe illness, while, of 38 antitoxin-protected chicks injected with the same strains, 33 survived and 5 died, 3 of them from non-specific causes. Of 36 chicks injected with 26 strains of avirulent *C. diphtheriae,* 34 survived and 2 died. In addition, of fifty chicks receiving thirty strains of diphtheroids, both *C. xerosis* and *C. pseudodiphtheriticum,* all but one survived with no apparent illness. The possibility of using chicks as test subjects in determining the virulence of cultures of *C. diphtheriae* is thus clearly indicated.

Results obtained with toxic filtrates were equally definite. A preliminary experiment has shown that chicks succumb to *intraperitoneal* injection of as little as 0.5 guinea-pig-M.L.D. of toxin. In Table 2 details are given concerning a group of 48 chicks receiving five different doses of toxin. The data indicate a susceptibility approximating that of 250-gram guinea pigs. In those chicks designated as "ill," paralysis of the wings and legs was a prominent feature. The chicks given doses of toxin larger than 1.0 M.L.D. died promptly. Those receiving less than 1.0 M.L.D. also sometimes died or were ill, but the effect of the toxin was definitely delayed, and paralysis was sometimes not manifest for 36 hours. The contrast between 1.0 M.L.D. and 0.5 M.L.D. in this respect, for example, was quite evident. The reaction to a given dose seemed to be more uniform in the chick than is the case with guinea pigs.

TABLE 2

EFFECT OF VARIOUS DOSES OF DIPHTHERIA TOXIN UPON SEVEN-DAY-OLD WHITE LEGHORN CHICKS

Dose of toxin (guinea pig M.L.D.s)	Chicks injected	Fate
3.0	6	6 dead within 26 hours
1.5	12	11 dead within 40 hours 1 very ill for 36 hours, survived, later showed paresis
1.0	13	6 dead within 72 hours 3 " " 5 days 2 ill for 2 days, survived, later showed paresis 2 no evident illness
0.5	13	2 dead within 72 hours 3 " " 5 days 2 moribund and killed on fifth day 1 dead after 6 days 3 ill for 2–3 days, survived, later showed paralysis 2 no evident illness
0.1	6	3 slightly ill up to 96 hours, survived, no damage 3 no evident illness

Thus, it has been shown that seven-day-old White Leghorn chicks succumb regularly within 48 hours to subcutaneous injections of 48-hour infusion-broth cultures of strains of *C. diphtheriae* which are virulent for rabbits. The chicks are rarely, if at all, affected by similar infections if protected by intraperitoneal injections of at least 200 units of antitoxin given 2 hours before. Cultures of *C. diphtheriae* and of diphtheroids, previously shown to be avirulent for rabbits, have no perceptible effect on the chickens.

Further, it has been demonstrated that week-old White Leghorn chicks have about the same degree of susceptibility to diphtheria toxin as 250-gram guinea pigs.

These experiments clearly indicate the value of the chick in the study of the diphtheria group of organisms. It is possible that both virulence tests and tests for the potency of diphtheria toxin can be satisfactorily made in week-old chicks. The economic advantages are obvious.[6]

MARTIN FROBISHER, JR.

THE JOHNS HOPKINS SCHOOL OF
HYGIENE AND PUBLIC HEALTH

THE ANTI-TRYPTIC PROPERTIES OF HEPARIN

INVESTIGATIONS of the possible prolongation of insulin action by inhibitors of proteolytic activity[1] have led to the discovery that heparin is a trypsin inhibitor. This resulted from the examination of many compounds in a search for a simple substance which might retard the activity of specific proteases.

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[6] The author takes pleasure in acknowledging, with appreciation, the technical assistance of Dr. Elizabeth I. Parsons and the advice and encouragement of Dr. Thomas B. Turner.

Crystalline trypsin inhibitor is a powerful anti-protease, but the preparation of this compound is time-consuming and the yields comparatively small, hence the search for a substitute. Blood plasma, while a good source of anti-protease activity, is too complex a mixture to permit a carefully controlled study, and the yield of trypsin-inhibitor which may be isolated from plasma[2] is apparently only a small fraction of its total inhibitory power. Similarly, the amino-acid concentrate of Northrop[3] as well as the anti-trypsin of egg white of Balls and Swenson,[4] while comparatively simple to prepare, did not lend themselves easily to further purification in our hands. Heavy metals as well as certain basic dyes are strongly anti-tryptic, but the addition of these substances to the proteases caused the latter to be precipitated from solution, a phenomenon which might easily explain the anti-protease activity.

Many basic dyes are powerful anti-coagulants,[5] and our observation that they may inhibit proteolysis suggested a relationship between the two processes. It was therefore logical to proceed to an investigation of heparin.

Table I presents representative data of the effects of heparin on the hydrolysis of casein by trypsin and chymotrypsin. These proteases were isolated from beef pancreas and recrystallized according to the techniques described by Northrop and Kunitz.[6] The heparin[7] was prepared to contain 2 mg per ml of water. The pH of this solution was 7.30. The casein (Hammarsten) was dissolved in sufficient sodium hydroxide to give a final pH of 7.5 and diluted to a concentration of 6 per cent. The enzyme solutions used contained approximately 0.03 mg of protease nitrogen per ml. The latter were carefully titrated with phosphate buffer to pH 7.30, using a standardized glass electrode system. No inhibition of trypsin is obtained unless the heparin is allowed to remain in contact with the alkaline trypsin solution for about thirty minutes before the two are added to the casein. This fact is particularly significant, since a parallel relationship obtains with trypsin and trypsin inhibitor.[6] Furthermore, the heparin-trypsin addition complex like the inhibitor-trypsin compound may be dissociated by acidifying to pH 3.0 for about 30 minutes to recover all the tryptic activity.

TABLE I

EFFECT OF HEPARIN ON DIGESTION OF CASEIN BY TRYPSIN AND CHYMOTRYPSIN AT 38° C. FORMOL TITRATION OF 3 ML SAMPLES OF DIGESTION MIXTURE EXPRESSED IN ML OF NaOH. (N/10)

Added to 25 cc of 6 per cent. casein after 30-minute contact	Time in minutes						
	15′	30′	60′	120′	180′	300′	480′
1 ml trypsin 1 ml H_2O	.01	.06	.14	.20	.33	.43	.53
1 ml trypsin 1 ml heparin	.00	.00	.04	.07	.13	.20	.29
1 ml chymotrypsin 1 ml H_2O	.05	.11	.18	.25	.31	.39	.48
1 ml chymotrypsin 1 ml heparin	.04	.11	.19	.25	.30	.39	.48

The data in Table I clearly indicate a marked inhibition of trypsin, especially during the first hour of digestion, but no apparent inhibition of chymotrypsin by similar concentrations of heparin. This effect has been checked many times by nephelometric as well as refractometric techniques to eliminate the possibility that the inhibition might be an artifact of the formol titration. Since trypsin catalyzes the clotting of recalcified oxalated plasma, and chymotrypsin is comparatively inert in this respect, the anti-tryptic propensity of heparin acquires additional significance. Preliminary experiments have indicated that in a given sample of plasma, added trypsin and heparin are mutually antagonistic and that clotting will not occur unless the amount of trypsin added is more than enough to neutralize the effect of heparin. Ferguson[8] has postulated the presence in blood of a "thromboplastic enzyme" which hypothesis is supported by the above observations.

Alterations in the anti-tryptic titre of plasma have been unexplained phenomena for several decades. Having the information that heparin is anti-tryptic, it may now be possible to correlate certain increases in blood anti-trypsin with increases in heparin. For example, Jaques and Waters[9] have recently shown that heparin is greatly increased in the blood of dogs in peptone shock, whereas in 1915 Jobling, Peterson and Eggstein[10] showed that peptone shock caused an increase in blood anti-trypsin. Further research on the amounts of heparin in various physiological states may present similar correlations.

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[1] M. K. Horwitt, *Am. Jour. Physiol. (Proceedings)*, 129: 89, 1940.

[2] A. Schmitz, *Zeit. physiol. chem.*, 255: 234, 1938.

[3] J. H. Northrop, *Jour. Gen. Physiol.*, 4: 227, 1921.

[4] A. K. Balls and T. L. Swenson, *Jour. Biol. Chem.*, 104: 409, 1934.

[5] H. Hermann, *Skand. Arch. Physiol.*, 76: 125, 1937.

[6] J. H. Northrop, "Crystalline Enzymes," Columbia University Press, 1939.

[7] Obtained from Connaught Laboratories, Toronto. Activity 110 units per mg.

[8] J. H. Ferguson and B. N. Erickson, *Am. Jour. Physiol.*, 126: 661, 1939.

[9] L. B. Jaques and E. T. Waters, *Am. Jour. Physiol. (Proceedings)*, 129: 93, 1940.

[10] J. W. Jobling, W. Peterson and A. A. Eggstein, *Jour. Exp. Med.*, 22: 129, 1915.

GLYCINE—AN ESSENTIAL FACTOR FOR THE GROWTH OF BACTERIOPHAGE[1]

BACTERIOPHAGE does not grow in bacterial cells suspended in water. We have found that bacteriophage will multiply in bacterial cells suspended in dilute solutions of pure glycine. The increases are from 8- to 10-fold during 3-hour incubation at 37° C. The bacteria do not multiply under these conditions in a 6.5-hour observation period.

The details of a typical experiment follow: Bacterial cells (*Es. coli*) in nutrient broth were infected with phage,[2] centrifuged down with their attached phage and resuspended in distilled water. 0.1 cc samples of this suspension were added to 0.9 cc samples of the following solutions: glycine (200 mg per cent.), nutrient broth, synthetic medium,[3] distilled water, phosphate buffer (pH 7.0) and 0.9 per cent. sodium chloride. In the nutrient broth and synthetic medium controls, phage growth (measured by plaque count) was rapid as we have described in a previous communication.[2] In the distilled water, buffer and saline controls there was no phage growth. In fact, in the water and in the saline the phage decreased. This we attribute to the death of phage-infected bacteria. In the glycine solution the phage increased, after a latent period of more than 35 minutes, to 6 times its original value at 100 minutes and 8 times the original value at 150 minutes.

The following substances were negative in this respect: asparagine, glucose, glucose in phosphate buffer, arginine, nucleic acid, alanine and diglycylglycine. The synthetic medium in which glucose and asparagine were the only organic constituents permitted phage growth, and yet these constituents separately did not support the growth of the virus.

Our sample of nucleic acid, which was probably impure, permitted the bacteria to grow slowly without accompanying phage growth. Evidently the processes within the cell which permit it to multiply are not identical with those required for phage growth, and *vice versa*.

The conditions under which the above experiments were carried out exclude the possibility of a failure of the virus to come in contact with its substrate in the bacterial cell. The failure of phage growth in distilled water and other pure solutions (*i.e.*, as distinguished from broth) is to be ascribed to the necessity of specific substrates for the growth of the phage.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

GLASS TUBES FOR REARING PHLEBOTOMUS AND OTHER INSECTS[1]

IN rearing Peruvian Phlebotomus sandflies in connection with studies on Carrión's disease, we have devised a new type of porous breeding-vessel which is also of value in the handling, transportation and rearing of other insects.

All methods of rearing sandflies in the laboratory involve keeping the engorged females at a high degree of humidity in a vessel with a moist inner surface on which the eggs may be laid. The commonest type of breeding-vessel is a small porous earthenware pot. This serves very well for mass rearing but is not convenient when large numbers of sandflies are to be handled separately. Adler and Theodor[2] secured oviposition by keeping females in glass tubes temporarily cemented to porous stone. We have endeavored to devise units complete in themselves which would combine the convenience of the glass tube with the essential functions of the porous breeding-pot, a result finally achieved by simply filling one end of the tube with plaster of Paris. Tubing with a bore of 8–9 mm is satisfactory for most sandflies, though a large species, such as *Phlebotomus peruensis*, requires larger tubing. A convenient length is eight centimeters. The plaster should extend into the tube for 10–12 mm. The open end is stoppered with cotton. These rearing-tubes may be made in quantity by standing bundles of cut tubing in dishes of freshly mixed plaster.

Before the tubes are used the plaster is moistened by contact with wet cotton. When containing sandflies they are stored, plaster end down, in moist earthen pots or in pans with a thick bottom layer of plaster. The highest degree of moisture short of condensation on the glass walls is desired. Plaster with the correct moisture content has a characteristic appearance which the operator soon learns to recognize. The eggs are laid on the plaster or on the glass just above it. The original tube may be maintained as a breeding-vessel for the larvae, but since there is usually not room enough for the progeny of one female, it is better to transfer the eggs to the standard breeding-pot. The eggs are not injured by immersion in water and transfer is easily made with a pipette and water.

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[1] Supported by a grant-in-aid from Mrs. Seeley W. Mudd.

[2] E. L. Ellis and Max Delbrück, *Jour. Gen. Physiol.*, 22: 365, 1939.

[3] For the composition of this medium, see Max Delbrück, *Jour. Gen. Physiol.*, 23: 643, 1940.

[1] Contribution from Departamento de Entomología Médica, Instituto Nacional de Higiene y Salud Pública, Lima, and Department of Comparative Pathology and Tropical Medicine, Harvard Medical School, Boston.

[2] S. Adler and O. Theodor, *Proc. Roy. Soc. London*, Series B, 116: 505–515, 1935.

Adult sandflies of either sex live as long in the plaster-plug tubes as in the standard breeding-pots, and we believe that the average yield of eggs is greater. The larvae, however, get along better and with less attention in the earthen pots. Our routine rearing technique is therefore a combination of the two methods. The tubes may be autoclaved and used a number of times, but in practice it is more satisfactory to use only fresh plaster.

In addition to serving as breeding-vessels for Phlebotomus, the plaster-plug tubes have proved useful in a number of other ways. They permit any desired degree of moisture and thus provide an excellent container for the transportation and temporary storage of living insects. They are in routine use for catching sandflies and other insects in the verruga zone and transporting them alive to the laboratory in Lima. They may prove useful in shipping live insects considerable distances. With these tubes we have secured, through the cooperation of a physician whom we instructed in their use, living sandflies and eggs from a region several days' journey from Lima.

Tubes of this type can doubtless be adapted to the rearing of various other insects. Though we have not had occasion to try them out extensively, we have used them successfully in rearing several species of fleas.

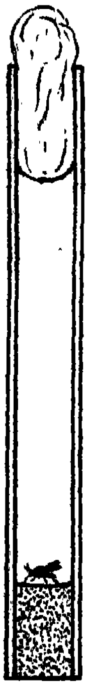

FIG. 1.

MARSHALL HERTIG

INSTITUTO NACIONAL DE HIGIENE
Y SALUD PÚBLICA, LIMA, PERU

THE ADMINISTRATION OF DRUGS TO RATS

IT is often necessary to give experimental animals quantitative doses by mouth, and frequently the material given is distasteful. Even those with much experience in giving a stomach tube to rats occasionally kill a valuable animal and at best the process is time consuming and unpleasant. A substitute technique has been found to be successful. Dissolve or suspend the material in a sucrose solution and measure it from a needleless tuberculin syringe into a rat's mouth. All rats like sugar and will take anything that can be made to taste sweet. Bile salts and other bitter material is consumed better in suspension than solution. It is recommended that two or three practice periods precede the experimental feeding. If the rat lies on its back with head slightly raised, there is no danger of spilling if the stream from the syringe is adjusted to the rate at which the rat laps. Most rats will try to turn over until this position is conditioned to the pleasure of drinking the sugar water.

This method has been used on several hundred rats, including many suffering from complete anorexia due to adrenalectomy or severe diseased conditions. Vitamins, ethynil testosterone and other hormones, sulfapyridine and many other substances have been given. The method has failed only in the administration of such irritants as CCl_4, where the trauma to the tissues of the mouth outweighs the appeal to the "sweet tooth."

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KEEP BOTTLE-TOPS FREE FROM DUST

LABORATORY bottles invariably gather dust. After pouring from them fluid remains on the lip and around the stopper, to dry out, effloresce or otherwise create and attract dust. Cleaning them daily is a time-consuming labor, with danger of contamination from the usual wet cleaning-cloth. Such dirt and contamination may affect laboratory procedures adversely, particularly in the case of preparations for microscopic study.

A simple and effective means of keeping bottle-tops clean is to cover each with an inverted paper drinking-cup. These cups may be had in various sizes to fit different types of bottles; they are inexpensive and may be discarded when soiled.

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BOOKS RECEIVED

American Philosophical Society, Proceedings. Vol. 82, No. 5: Centenary Celebration; The Wilkes Exploring Expedition of the U. S. Navy, 1838–1842 and Symposium on American Polar Exploration, February, 1940. Pp. 519–947 + v. Illustrated. The Society, Philadelphia.

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BOURNE, GEOFFREY. *Nutrition and the War.* Pp. xii + 126. Cambridge University Press, Macmillan. $1.00.

LEJAY, R. P. PIERRE. *Étude Gravimétrique des Iles Philippines.* Pp. 129. 6 figures. Imprimerie de T'Ou-Sè-Wè, Shanghai.

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PANUM, PETER L. *Observations made during the Epidemic of Measles on the Faroe Islands in the Year 1846.* Translated from the Danish by ADA S. HATCHER. Pp. xxxvii + 111. Delta Omega Society and American Public Health Association, New York. $2.50.

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ADDRESS OF THE PRESIDENT OF THE ROYAL SOCIETY[1]

By Sir WILLIAM BRAGG, O.M.

The tragic happenings of these times have necessarily had their effect on the activities of the society. On the outbreak of war, the offices were moved—as had been decided sometime beforehand—to Trinity College, Cambridge, and I take this opportunity of expressing the gratitude of the society for the hospitality which we have found there. We could not have wished, if we were to be in exile, any greater happiness than to be housed in the college of Isaac Newton and many another of our fellows, past and present. Many of our irreplaceable possessions were removed to places of safety.

The meetings for the reading of papers have been suspended temporarily, but their early resumption is possible, and will certainly take place if circumstances allow. The publication of papers has not been interrupted, though it has seemed well to place some limits on their length. Most of the other activities of the society, including the administration of funds for research, are proceeding as usual.

The council's report deals with the business of the society during the past year, and the second volume of "Notes and Records" tells of many other matters of interest. I am thereby relieved of the necessity of referring in this address to several subjects already considered. I propose to say a few words on the general position of the Royal Society at this special time. But first I would speak of the debt which the society owes to its retiring treasurer, Sir Henry Lyons. We owe to him the complete and valuable reform of our finances carried out during years when the monetary transactions and responsibilities of the society have been growing at a great rate; he has made welcome improvements in the conduct of our business; our house and rooms are much the better for his care: nor can we forget the successful introduction and maintenance of "Notes and Records" to which I have already referred. In very many other ways we are his debtors. The society parts reluctantly with the treasurer, who has so splendidly filled his office for the past ten years. Perhaps his effectiveness does not disappear with the tenure of his office, for as long as he is with us his critical yet friendly eye will make it impossible for any one to be careless in the society's business.

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[1] Anniversary meeting, November 30, 1939.

A very large number of our fellows are serving in different capacities for the prosecution of the war. Twenty-five years ago the war, which to so many of us seems to have been resumed after a very short interval, taught the world the importance of science and its application, and that not merely in the war itself but in many subsidiary activities and indeed by example and by inference in all human undertakings. The lesson has not been forgotten in the years that have intervened, and the present outbreak finds all our defence services far ahead of 1914 in the employment of science and scientific men. For this we must be profoundly thankful; for it is clear now that any nation which fell behind in this respect by even a few years of study and application would quickly be overwhelmed. It is early to form a complete estimate of the effectiveness in the present war of the attention that has been given to science in the last twenty years, but there is no little promise in what we are permitted to know of what is going on. There is evidence that the application of science in all sections of war-activity, land, sea and air, are proving their value and more than justify all that has been spent upon them.

There is indeed a wide-spread recognition of the general effectiveness of science. The ways of using science and scientific men are being slowly discovered. But the process is slow. It would, I think, be hastened, if certain fundamental truths were generally known and recognized. I venture to state them in the form of a few propositions:

(1) Science, that is to say, the knowledge of nature, is of fundamental importance to the successful prosecution of any enterprise. For example, a nation is obliged to make all possible use of science in preparation for war, whether aggressive or defensive: and, again by way of example, in the maintenance of public health and social welfare. Of course, science is not alone in being a necessity in either case.

(2) Science is of general application. There are not one science of chemistry, another of electricity, another of medicine and so on: there are not even distinct sciences of peace and war. There is only one natural world, and there is only one knowledge of it.

Experience shows that an advance in knowledge or technique or skill in any direction may be based on some item of knowledge acquired in a far distant field of research. For that reason, it is necessary to resist strongly a natural tendency for those who study science or apply it, to separate into groups without mutual communication.

(3) Fruitful inventions are alway due to a combination of knowledge and of experience on the spot. Unless the man with knowledge is present at the place and the time when some experience reveals the problem to be solved he misses the fertilizing suggestion. Neither can the mastering idea suggest itself to the man who has the experience only but no knowledge by which to read the lesson that the experience teaches. The man with knowledge may be a temporary or special introduction, or, which is much better, he may be the man who meets with the experience.

(4) There are difficulties peculiar to the application of science to war purposes. While the war proceeds scientists as a body are anxious to put all their knowledge at the service of their country: but when the time comes they are anxious to get away to their work on pure science or the applications of science to the problems of peace. Government may preserve and most fortunately has preserved a nucleus of able scientific effort during the last 20 years of peace, so that a certain connection is maintained between these particular applications and the general body of science: but from the very nature of their respective occupations, and on account of a certain secrecy which one of the two bodies is forced to maintain, the connection is not always strong. It can easily happen that the solution of a particular difficulty in the war service may lie in some piece of knowledge far away from the immediate science of the enterprise and unknown to those who need it.

I believe that the four statements which I have just made and briefly amplified are true, and must be acknowledged to be true by all careful observers. That being the case, it is of the utmost importance to move in the direction in which they point. We must ourselves be interested in any attempt to do so. We must wish to see that the vast and growing body of natural knowledge is most effectively employed in the service of the nation.

The tremendous use of science in the present war compels us to think about the method of its use. Many suggestions have already been made: as, for example, that a ministry of science should be formed immediately. In my opinion there is no solution here. A ministry would be too formal and rigid at any rate for immediate needs; the most successful ways of using knowledge are personal and elastic. We must not attempt too much at once. We might be content if we could in some way bring science as a whole into close relation with government as a whole, if we could attach a central authority of science to the central authority of the country. The immediate application of science in any department of the country's business should be made from within the department, not from without, and we have already a number of instances in which this principle is followed. The Department of Scientific and Industrial Research, which we are proud to think of as an original device of the society, correlates many branches of industry with science: it is entrusted with the administration of large funds, and has had great successes. Similarly, the Medical Research Council administers funds and encourages research in the interests of the health of the people, and again the Agricultural Research Council has its own field of action. Each department of the defence forces takes care of its own applications of science. This is satisfactory so far as it goes. The need is rather for means whereby the government, in its care for the whole sweep of the country's business, can rely on and make use of the whole range of scientific knowledge.

It would seem that our society itself is a body which is not used as it might be, though, as I have said already, a large number of our fellows are individually taking part in the application of natural knowledge. Within its ranks are to be found men with knowledge of every form of natural science. It would be well if by way of some small group of fellows, selected for the purpose, it were consulted without hesitation whenever the need arose, and if it were kept so well informed that it might foresee occasions and needs. If that could be achieved, a forward step would be made, which in due time would be followed by others. It would be a very proper step to take, being a continuation and extension of a process which already exists. To use a modern term, science is irresistibly making its way into general use by a "peaceful penetration," which in the end is far more effective than a violent movement; all the more so because science is not out to fight present methods of rule and economy but rather to strengthen with new knowledge of facts and principles. We have often proved in this country the practical value of making use of existing institutions rather than founding new ones, when the old are full of vigor and can carry new grafts without strain. That is why the Royal Society, as a body of high consultative value, is ideally fitted to form the next link between knowledge and practice.

There are two subsidiary consequences of the present position of science which need to be remembered. We have not long passed the stage, if indeed we have quite gone past it, when our knowledge of nature is used as a reference library is used. The knowledge is there, on the shelves, to be taken down when any one wants information on a particular point and happens to remember where possibly it may be obtained.

Any one who wants to use a library effectively must already have some knowledge of the same nature as that which he hopes to find there. If not, he does not know where or how to look; nor can he grasp fully what he finds, even if he happens to hit upon the right book. For a parallel reason, it is most important that a general knowledge of science should be diffused among the people, and especially among those to whom it falls to guide and govern.

A second consequence is that the supply of men capable of the study and interpretation of the natural world must be made continuous. An instance, special to the moment, is the present policy of reserving able men in their final year at universities and technical institutions so that they are not absorbed too early into the fighting services nor into inappropriate branches thereof. This is necessary; but it is not all that is necessary. National interests demand that the water shall not be diverted higher up the stream.

And it may be well to add here that the care for those who can in due course be expected to supply the knowledge of nature and to assist in its use is not the nation's only care. It would be absurd to overlook other knowledge: I am but limiting myself to matters with which the society is especially concerned.

Let me now turn to a question of pure science. When the new methods of x-ray analysis were first introduced a quarter of a century ago there was naturally no clear realization of the extent and character of the fields of research in which they would eventually be employed. Certain applications were found for them at once, but the years have brought wide and unexpected developments. Some of these are gathering themselves together, and, in conjunction with other methods of physics and chemistry, begin to form what might well be called a new branch of science.

In the early phase of the x-ray crystal studies the object of interest was the perfect crystal; in the later phase attention is directed towards the departures from perfection, which turn out to be of the greatest interest and importance.

It will be remembered that the method of analysis of the structure of matter by means of x-rays was based upon a suggestion made by Dr. Laue. If the atoms in a crystal were in regular array, the passage of ether waves through the crystal should be accompanied by diffraction effect provided that the lengths of the waves were of the same order of magnitude as the spacings of the atoms. In the case of the ether waves emitted by an x-ray bulb—if indeed the x-rays were ether waves, of which there was some doubt at the time—there were reasons to suppose that the wavelengths were of the magnitude required. The experiment was made, and was successful.

The diffraction effects provided means whereby the crystalline arrangements could be calculated. The researches of the first few years of x-ray analysis were therefore concerned with the character of the crystalline arrangement in a number of the simpler cases. As confidence grew and skill increased more difficult structures were attacked, and indeed it has been very surprising to find what complicated structures can be unravelled. One helpful circumstance has been the existence of families of substances, since the progressive differences in the members of a family gave rise to corresponding changes in the diffraction patterns. Thus, for example, the large family of silicates was examined and the connections between composition and diffraction effects, and again between the latter and structure, were observed and compared. Certain simplicities and informities then appeared and it became possible to put in order a mass of details which had not previously appeared to have any relation with each other.

It was not long before the results in the field of research became so numerous that books of no small size were required to contain them. In thousands of cases the dimensions of the unit cell of the crystal were determined, and at least the space-group or character of the arrangement of the atoms within the cell. In a number of these cases the exact relative positions of the atoms could be found, though this additional task has often been formidable. Work of this kind continues and rightly so, to be the occupation of many investigators. All such work belongs to the first phase to which I have referred.

The application of the x-ray methods has for some time been entering on a second phase. It now deals with a natural phenomenon differing entirely from that which was the first to be examined. The earlier work was concerned with the arrangement of the atoms in a perfect crystal, that is to say a body in which the mutual forces are balanced, and the arrangement is complete. Thermal movements may still be there, but the average dispositions of the atoms are settled, and are uniform throughout the body of the crystal.

It is doubtful whether there is such a thing as a perfect crystal large enough to be handled; perhaps the crystals of diamond and graphite are nearest to perfection. In almost all cases there are deviations from complete uniformity. A crystal that has every appearance of being perfect may consist of an assemblage of minute crystallites, more nearly perfect individually but lacking uniformity of orientation to a greater or less degree. Other bodies that do not appear to be crystalline at all may consist of crystallites oriented so irregularly that the bodies seem to be isotropic. The crystallites may vary in size as well as in relative orientation. Two or more crystal forms may be present in the same body, so mixed together that only the x-ray methods can make any attempt to disentangle them. Sometimes one greater lattice overrides in a more or less regular fashion a smaller lattice as a pattern of ploughed fields may override a pattern of furrows. Also a lattice may be distorted by strain. In a substance in the liquid state there may be associations and partial arrangements sufficient to show x-ray diffraction.

Moreover, arrangements and dimensions may vary with time, both in solids and liquids; some forms or extents of arrangement may even disappear, new forms may appear at the expense of the old. Perfection of crystalline arrangement is a goal which is never achieved. And in fact the processes of the world are based upon such deviations from perfection, and their continuous modification. If all arrangements of atoms were complete, there would be nothing left but stagnation and the peace of death.

It will be seen, therefore, that a new field of research of extraordinary interest is being opened up. It is in this field that the physicist and chemist and indeed scientists of every persuasion must look for explanations of many of the properties of their materials such as their relations to magnetism and electricity, thermal conductivity, tensile strength, various surface effects and so on: as also the time-changes in these properties, such as the creep to which the engineer has to give so much attention. Properties such as these have been called by Orowan and others the "sensitive" properties since they depend on the particular state of a body, which state in turn depends largely on the conditions of the new field of which I am speaking. The biologist finds interest in it, because the life processes seem to involve the relations between large aggregates, molecules or assemblages of molecules, with one another or with media in which they are imbedded. Somewhere in this field life and matter are first found in association.

It may seem unreasonable to expect help in the resolution of such complications from the x-ray diffraction effects. It is to be remembered, however, that the x-ray photographs are very rich in information. The gratings are three-dimensional and may be examined from a variety of aspects; each photograph or spectrometer record is a two-dimensional diagram of positions and intensities of diffracted spots. A light spectrum of the ordinary kind is uni-dimensional only. The photographs vary in definition, being less easy to read as they deal with more complicated cases; but the technique is rapidly improving.

The earliest of these phenomena of the larger field was the so-called mosaic effect. A crystal of rocksalt, for example, is a mass of small crystals, each of which approaches to regularity far more completely than the whole. The separate crystallites are not in perfect alignment with each other. Hence arose one of the perplexities of the early days. It was extraordinary to find that the less perfect crystal reflected the x-rays in greater intensity than the more perfect and that the reflections from the face of a crystal, quartz, for example, might be increased if the surface was roughened. The puzzle is solved if we remember that, as Darwin and others pointed out, one crystallite may screen another. If the orientations of the two are exactly the same, and they are set at the proper angle for reflecting the incident x-rays the first crystallite will partly absorb the rays in producing its own reflection and the lower will not have its full opportunity. But if, as is usual, the crystal is moved through small angles about the above setting so as to give every crystallite its chance—provided that the x-rays can penetrate the crystal so far as to reach it—then the second will be in the right orientation for reflection when the first is not. The incident rays get through the first and are reflected by the second; the integration of all effects therefore gives a larger total when the crystallites are not parallel. This mosaic character is very common, even in crystals of the purest material. There are indications, as remarked by Goetz and others, that in some cases at least it is the state of greater equilibrium. Thus W. A. Wood shows that crystals of copper and other metals of extreme purity are reduced by cold working to crystallites in more or less complete disarray. The substances do not then return to their former state, though they can be taken some way toward it by moderate heating. To restore them to their original state it would be necessary to begin over again from the melt. A similar effect was shown by Ewald to occur in the case of rocksalt. It may also be significant that of the two forms of diamond examined by Robertson and Fox, that which is the more transparent to infra-red and ultra-violet and may therefore be taken to be in greater internal equilibrium is also the one in which there is some mosaic character.

If this form of disintegration of a larger crystal into crystallites is really due to the release of energy, it might be expected to proceed until the process was complete and the substance became amorphous. Wood shows that it does not proceed indefinitely and that the copper crystallites have an average linear dimension of about 700 A; for silver the figure is 800, for metal 1,200, and so on. The disintegration ceases at a certain point. The metals were of extreme purity. Unless it appears that the mere trace of impurity governs the effect, it must be supposed that the disposition to form aggregates of definite magnitude is present in the copper atoms themselves.

The presence of crystallites of a definite pattern, their dimensions, their preference for any particular orientation in relation to the body which contains them and their proportional amounts are all determined by the x-ray photographs. It is to be remembered that the diffraction spectra of a compound of different crystallites do not modify nor disturb each other's evidence. The data on which calculations are based are the forms and intensities of the spots and lines in the x-ray photography. The calculations are often difficult and lengthy because so many factors have to be taken into consideration; in fact there is plenty of evidence, and the most troublesome part of the business is its interpretation.

It will be readily understood that such measurements as these can be of great assistance in the study of metals. It is possible to examine in a new and most effective way the phase diagrams of the metallurgist, and the various effects of composition, temperature and time, and this not only for binary alloys but also for ternary and still more complicated mixtures. With these powers in hand, and with the remarkable accuracy of the modern x-ray spectrometer which can show minute changes of form due to temperature or an admixture of foreign atoms and can show also any variations in the extent of order and disorder in the atomic arrangements, it is not surprising that theoretical metallurgy has acquired a new life and that practical metallurgy begins to gain thereby.

Since the x-ray methods can do so much to discover the composition of molecules, even very large molecules such as the phthalocyanines (Robertson) or the sterols (Bernal, Crowfoot and others), and also to determine the arrangement of the molecules in crystalline aggregates and yet further to find any preferred orientations that there may be, the methods can be fitly used for the examination of fibrous materials. In cotton, silk, rubber and many other substances there are long chain molecules which are linked together into crystallites having preferred orientations along the length of the fiber. So also nerve, muscle, horn and such like contain proteins and keratins in fibrous forms. It is even possible, as Bernal has shown, to find some details of the composition, structure and arrangement of immense molecules such as those of a virus. Very interesting papers on these subjects have been communicated to our society, some of them during the present year.

It is to be observed that the extension of the x-ray methods to these larger scale problems is greatly facilitated by extrapolation from simpler observations. In the case of organic substances the modes of assemblage into characteristic combinations of atoms, such as the association of carbon atoms in the benzene ring, are governed by rules which are so closely followed in the simpler cases that they can be assumed to hold in the more complicated. These rules relate to the distance from atom to atom in various cases, and the mutual orientations of atoms. In this way very important suggestions have been made in respect to the construction of the more difficult assemblages.

It is to be remembered, of course, that there are other physical methods of observation which contribute to the understanding of the complex substances of nature, which are all the more efficient now that the x-ray methods are able to make their characteristic contribution. First of all comes chemical science, the power of which is so obvious and well known that I need not do more than refer to it. Optical properties have been found to be extremely useful. So also the magnetic properties are found to be closely related to structure. Thus, for example, the disposition of a molecule containing benzene rings can often be predicted from diamagnetic measurements.

The sum total of these powers, some new, some old, all reinforcing each other in a common advance, is so great that, as I have already said, a new field of inquiry of first-rate importance has been well entered. That which the eye can see is one thing; that which the microscope reveals is another. Far beyond any vision is the individual atom and the atomic nucleus, of which so much has been discovered in recent years. But a vast range of magnitudes, lying approximately between 10 and 10,000 A has never been accessible to the direct attack which the ranges on either side of it have experienced. Within this range lie all the processes which are concerned in the building of living substances, animal and vegetable, and in the changes of growth and decay. In this range lie also elements that are the origin of the properties of our materials, alloys, glasses, fibrous substances of all kinds, and here take place transformations which change these properties, some of them rapid especially when urged by heat, some so slow that centuries must pass before they become visible or effective. The recent advance into this new field is only the preliminary to what is sure to follow. We have before us an inquiry of supreme interest.

OBITUARY

HAVEN METCALF

1875–1940

DR. HAVEN METCALF, principal pathologist in charge of the division of forest pathology, of the U. S. Bureau of Plant Industry, died on May 23, at Washington, after long suffering from an incurable disease. He was born on August 6, 1875, the son of George Shepard and Prudence (Grant) Metcalf of Winthrop, Maine. The family history is given extensively in E. S. Stackpole's "History of Winthrop." His earliest American ancestor, Michael Metcalf, son of Rector Leonard Metcalf, of Totterford, Norfolk County, England, came over on the ship *John and Dorothy* in 1637. The Metcalf clan was prominent and included physicians, ministers, public officials, professors, authors and editors and manufacturers. Joseph Addison Metcalf (1795–1845) founded a school now known as Gettysburg College (Pa.).

After finishing high school at Winthrop, Metcalf attended Colby from 1892 to 1894 and Brown, from which he received the degrees of B.S. in 1896 and A.M. in 1897. This was followed by further graduate work in botany, bacteriology and mycology at Brown in 1897–98, Harvard in 1899, Indiana in 1900 and with Professor Charles E. Bessey, at Nebraska, from which he received his Ph.D. in 1903. On June 28, 1899, he married a fellow student of Colby and Brown days, Flora May Holt, who died on April 26, 1935. Interspersed with his research, he was an instructor in botany at Brown from 1896 to 1899, instructor in bacteriology at Nebraska from 1901 to 1902, and assistant professor in botany and bacteriology at Clemson Agricultural College and state botanist, South Carolina, from 1902 to 1906. He also gave special lectures at Martha's Vineyard Summer Institute from 1896 to 1899 and the South Carolina State Summer School from 1903 to 1905. He joined the U. S. Bureau of Plant Industry as pathologist in 1906–07, and thereafter organized and administered the Division of Forest Pathology and its many branch offices.

Metcalf joined the Department of Agriculture when it was beginning to break away from purely systematic work and was attracting numbers of university graduates trained in the quantitative and mathematical methods of physics, chemistry and other sciences. Dr. Lyman J. Briggs, then biophysicist in plant industry, tells of the scientific club embodying such a group of enthusiastic young scientists, including Dr. E. R. Smith, in whose pathology laboratories Metcalf had worked a year. Smith reported at one meeting that a certain organism behaved differently on culture-media neutral to methyl orange than it did on the same media neutralized to phenolphthalein. He was puzzled. Briggs explained the matter in terms of the then current rudiments of present-day pH control. Metcalf had consistently believed in the advantages of the application of the physical sciences to biology. Shortly afterwards he visited the laboratories of the writer in the Johns Hopkins University, where colorimetric (indicators), electrometric and conductimetric pH methods were being evolved. Official cooperations on the development and application of such physical-chemical technique to forest pathology begun by them in 1914 continued to the present time, and were used increasingly in Metcalf's laboratories. He established close contacts with a number of leading universities and their scientists, many of whom later joined his staff, in order that forest pathology might be developed and applied with broad understanding.

His cooperative attitude, his stimulating combination of realism and idealism, of sound science with practical application, soon put him into a position of leadership in both state and federal activities. The development of forest pathology from the status of an academic study of tree fungi to its present standing as a science on which the arts of silviculture and forest utilization are increasingly dependent, has been largely due to his own efforts and those of the organization which he developed. The study of shade tree diseases, to which he gave special attention, contributed to the development of a sounder base for tree surgery and general tree care. The many-sided efforts against chestnut blight and the precedent-making campaign against white pine blister rust are two of the best-known outgrowths of his early work. Despite sharp opposition by influential mycologists, he early established the Asiatic origin of the blight; his educational work on the menace of introduced diseases gave impetus to the legislative and quarantine action that ended what he characterized as the period of "free trade in plant diseases."

It was inevitable that a man with his knowledge, vision and executive ability should have to share them in many public relations. He was president of the American Phytopathological Society in 1914, of the Botanical Society of Washington in 1920, and of the National Shade Tree Conference in 1925–26; associate editor of *Phytopathology* (1910–14); member of the American Botanical Society, Society of American Bacteriologists, Society of American Foresters, Washington Academy of Sciences, New England Botanical Club, Washington Biological Society, American Phytopathological Society (sustaining life member) and a fellow of the American Association for the Advancement of Science. He represented the United States in the International Conference on Phytopathology in Holland in 1923, and in Italy in 1908 arranged for importation of the colusa rice now grown extensively in California. He was a member of Phi Beta Kappa, Sigma Xi and Delta Upsilon fraternities and of the Cosmos Club and Washington Country Club.

Metcalf published eighty-four articles on diseases of forest trees, sugar-beet soft rot, bacterium teutlium, nematodes in plant decay, rice blast, chromosomes, immunity and scientific administration.

Because of his quiet, judicial temperament, Metcalf's advice was sought by friends and colleagues and given freely. Many and generous were his private contributions to charity and to the education of young people.

When advised by physicians that he must give up all personal scientific work and restrict his activities entirely to administration, he and Mrs. Metcalf found great enjoyment in books, music, art, genealogy and the theater. Their carefully selected library of 5,000 volumes and their quiet social relations attested wide culture.

Tragically his body lacked the vigor of his personality and mind.

S. F. ACREE

WASHINGTON, D. C.

EDWARD PAYSON VAN DUZEE

EDWARD PAYSON VAN DUZEE, curator of the department of entomology, California Academy of Sciences, San Francisco, died on June 2, 1940, after a brief illness. He was born in New York City on April 6, 1861, was educated in public and private schools, served as assistant librarian and as librarian of the Grosvenor Library of Buffalo, New York, for 27 years, going to California in 1912. After two years spent in San Diego and in the Scripps Institution at La Jolla, he became an instructor in entomology in the University of California for 1914–16, and was appointed curator of the department of entomology and assistant librarian in the California Academy of Sciences in 1916.

As a student of entomology from his earliest youth he became a leader in faunistic studies, especially in the Hemiptera, his list of scientific publications reaching 165 in number. His "Catalogue of the Hemiptera North of Mexico," a volume of over 900 pages published by the University of California in 1897, stands as an example of scholarly scientific research and is invaluable to entomologists everywhere. Under his guidance the entomological collections of the California Academy of Sciences have grown from some 30,000 to well over 1,000,000 specimens and form a national center of research. He founded the *Pan Pacific Entomologist* in 1924, and continued as its editor-in-chief until the past few months, when his failing strength compelled its relinquishment.

His kindly, helpful attitude toward his colleagues, and especially toward younger students of insects, and his contagious enthusiasm and self-sacrificing devotion to his work will cause his memory to be cherished by all who knew him, while the department he built up will remain his enduring monument.

F. M. MACFARLAND

STANFORD UNIVERSITY

RECENT DEATHS

CHESTER O. REED, professor of agricultural engineering at the Ohio State University, died on June 11. He was fifty-four years of age.

DR. MELVIN RANDOLPH GILMORE, curator of ethnology in the Museum of Anthropology of the University of Michigan, died on July 25 at the age of seventy-two years.

PROFESSOR COUNT GIOVANNI LORENZINI, president of the Italian Biochemical Institute at Milan, known for his studies of vitamins, was killed in an automobile accident on July 24.

Nature reports the death of Dr. L. S. Bagster, professor of chemistry in the University of Queensland, Brisbane, aged fifty-three years, and of Dr. Samuel Klein, professor of the historical geography of Palestine in the Hebrew University, Jerusalem.

SCIENTIFIC EVENTS

THE HALL OF INVENTIONS AT THE WORLD'S FAIR

THE Hall of Inventions at the World's Fair in New York celebrates the one hundred and fiftieth birthday of the U. S. Patent System. It illustrates the beginnings of industrial and technical life in America and includes early working models of devices and machines from which many of the most important industries have developed.

There are 4,000 items presented in the various exhibits. These include the cotton gin, sewing machine, automobile, railway devices, production machinery and household helps. One of the displays consists of a scale model of the snow cruiser now with Byrd's Expedition in Antarctica. Patented and trademarked formulas, and even patented plants and flowers, have their part in the exhibit.

It was the practice formerly to submit actual working models when applying for a patent. Many of these original models are on exhibition in the Hall of Inventions. They come from the Drexel Institute and the Franklin Institute; the Massachusetts Institute of Technology; the Stevens Institute of Technology, and the Smithsonian Institution.

There is also a fully equipped experimental shop where machines and projects are built from early blueprints. The shop includes 6″ and 10″ lathes, drill presses, shapers, grinders, vises, tools and attachments manufactured by the Atlas Press Company, Kalamazoo, Mich.

The exhibit is open from 10 A.M. to 10 P.M. daily.

THE AMERICAN COORDINATING COMMITTEE ON CORROSION

THE second annual meeting of the American Coordinating Committee on Corrosion was held on June 27, at Atlantic City. Dr. F. N. Speller, of Pittsburgh, consultant on corrosion, was formally named chairman for the coming year. Dr. R. M. Burns, of the Bell Telephone Laboratories, was named vice-chairman and Dr. G. H. Young, Mellon Institute of Industrial Research, secretary-treasurer.

The committee was organized two years ago to coordinate research activities in the field, and is patterned after similar organizations in England, Holland, Belgium and other countries abroad. Cooperation has been promised by all the major companies and independent laboratories that are actively engaged in corrosion investigations.

The committee is at present composed of official delegates from the American Chemical Society, the American Electroplaters Society, the American Foundrymen's Association, the American Gas Association, the American Institute of Chemical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Heating and Ventilating Engineers, the American Society of Mechanical Engineers, the American Society of Refrigerating Engineers, the American Society for Metals, the American Society for Testing Materials, the American Water Works Association, Battelle Memorial Institute, the Electrochemical Society, Mellon Institute of Industrial Research, the National Bureau of Standards, the National District Heating Association, the Society of Automotive Engineers and the Technical Association of the Pulp and Paper Industry.

At the meeting just passed, the American Welding Society, the Chemical Foundation, the Engineering Foundation and the National Research Council were also elected to membership.

TRIBUTE TO THE LATE DR. W. E. BRITTON, STATE ENTOMOLOGIST OF CONNECTICUT

A TRIBUTE and biographical sketch of the late Dr. W. E. Britton, the first state entomologist of Connecticut, is printed as an introduction to the thirty-ninth report on entomological work in Connecticut. It is the first report of Dr. Roger B. Friend, Dr. Britton's successor.

The report, which occupies 112 pages, contains, in addition to the introduction, a complete review of the year in entomology, sections of which were contributed by members of the staff. There are chapters on the insect record of 1939; reports on inspection of nurseries and bees, control of the gipsy-moth, the Japanese beetle, carrier of the Dutch elm disease; miscellaneous insect notes, and the department publications of the year.

This report is the latest of an unbroken series that has been published annually since the office of state entomologist was created by an act of the General Assembly in 1901. Dr. Friend writes:

> The state entomologist undertook his duties with energetic enthusiasm. He not only met various situations as they arose, but, prophetically, anticipated future problems and was prepared for emergencies. The demands on his

office increased as time went on, and the high quality of service rendered the people of the state engendered confidence in the work. With the increase of personnel to the staff and a multiplication of tasks, including research, control, quarantine, publication and the manifold activities involved in keeping track of insect pests and informing the people of the state about them, Dr. Britton's work gradually shifted in emphasis from research to administration.

In conclusion, he sums up the character of Dr. Britton in the following words:

> A man's accomplishments depend on his personal qualities. Dr. Britton adhered to sound principles in his personal affairs and his relations to members of his staff and other associates in his profession, as well as to his community. Although inherently conservative and personally rigidly adherent to an ethical code which demanded honesty, integrity and candor, he was at the same time liberal in his judgment, tolerant in his decisions, disinterested and generous. To the members of his staff he was always stimulating. Interested in every phase of their activities and demanding intelligent application to the task at hand, faithful performance, loyalty and devotion to the public welfare, at the same time he neither interfered unduly in their work nor evaded responsibility for their acts. He was excessively careful in giving them credit for whatever they accomplished. Those outside the Experiment Station with whom the state entomologist cooperated in many phases of entomological work found him an ideal associate, and the community in which he lived benefited by his presence. In spite of his manifold tasks and remarkable productivity, he took the oscillations of fortune philosophically, confident of the outcome, unperturbed, saved from fretfulness by a serene disposition and a sense of humor.

IN HONOR OF JULIUS HERMAN FRANDSEN

At the thirty-fifth annual meeting, held at Lafayette, Ind., of the American Dairy Science Association, a tribute was paid to Professor Julius Herman Frandsen, professor of dairy industry at the Massachusetts State College, "in recognition of outstanding service to dairy science in America, particularly in the conception, advocacy and establishment of the *Journal of Dairy Science* which he so carefully nurtured and successfully edited and managed for eleven years—a substantial and far-reaching contribution of inestimable value to the advancement of dairy research, teaching and practice."

Dr. H. B. Ellenberger, professor of animal and dairy husbandry at the University of Vermont and head of the department, presented the tribute. He stated that this was the third time that such an honorary tribute had been paid by the association to one of its members. In 1933 Professor Wilber J. Fraser, of Illinois, founder of the association, was presented with a framed "token of appreciation" for his "clear vision of the possibilities in advancing the cause of scientific dairying through a closer organization of the workers in the field" and for eminent service to the industry. In 1934 a similar "tribute" was presented to Dr. Otto F. Hunziker, of Chicago, for "outstanding leadership in dairy research and education" and in association affairs, and in 1935 a framed "tribute" was given to Dr. Martin Mortensen, of Iowa, in recognition of his "eminent service to the dairy industry . . . and his devotion to our association."

Dr. Ellenberger then gave the following particulars in regard to Dr. Frandsen's life and work:

> Professor Frandsen was born in Story County, Iowa, the central county of the central state of the cornbelt. He was raised on a farm and has been associated with dairying in one form or another all his life. He is a graduate of Iowa State College in the class of 1902, where I was a student with him and from which he received a Master of Science degree in 1904. In 1906 Matilda Madson, another I.S.C. graduate, became his wife and very active life partner.
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> From 1904 to 1907 Professor Frandsen was engaged in commercial work with Professor Mortensen. In 1907 he was appointed the first professor of dairy industry at the University of Idaho, where he remained as head of the department until 1911 when he became professor of dairy husbandry at the University of Nebraska. While there he was instrumental in securing the erection of the dairy building, dedicated in 1917, then recognized as the finest college dairy building in the country and still ranking as one of the best.
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> Leaving the University of Nebraska in 1921 to become dairy editor of farm papers, he again returned to teaching and research in 1926 as professor of dairy industry at the Massachusetts State College, the position which he now holds.
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> Professor Frandsen served as president of the Official Dairy Instructors' Association, as this organization was then named, during 1913 and 1914. In his presidential address of 1913 he made a strong plea for the establishment of a journal to be published by our association in the interest of dairy science and research. From that time through 1914–16, he at every opportunity advocated the establishment of such a journal. This ambition was realized, when at its 1916 annual meeting, this association approved the establishment of the *Journal of Dairy Science* and designated Professor Frandsen as editor-in-chief. It is interesting to note that this action was taken in Flint Laboratory, Amherst, Massachusetts, the building in which Professor Frandsen now has his office.
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> As editor of the *Journal of Dairy Science* from May, 1917, to January, 1928, Professor Frandsen has been the means of arousing, encouraging and advancing dairy research in a way and to an extent now recognized as outstanding and important.

APPOINTMENT OF DR. BRUNO ROSSI AT CORNELL UNIVERSITY

Dr. Bruno Rossi, research associate at the University of Chicago, formerly professor and head of the department of physics at the University of Padua, has been appointed associate professor of physics at Cornell University. Dr. Rossi lost his position at Padua in 1938 when the racial laws went into effect. After spending some time at the Bohr laboratory in Copenhagen, he received a fellowship at the University of Manchester, working with P. M. S. Blackett, Langworthy professor of physics in the university. A correspondent writes:

> Dr. Rossi is recognized as one of the five leading investigators in the field of cosmic radiation. In recent years he has published more than thirty papers on the subject and has conducted an incredible number of investigations, some of which are yet unpublished. Dr. Hans Bethe, of Cornell University, with whom Dr. Rossi will be associated, states, "There is hardly any paper on the subject of cosmic radiation in which Rossi's name is not quoted repeatedly." As a result of his research the original, as well as the most exact and recent work on the production of "showers" in cosmic radiation was produced. This led to a confirmation of the quantum theory of radiation up to tremendous energies of electron volts.
>
> Dr. Rossi has been associated with many of the greatest physicists. Together with Fermi, Nobel-Prize laureate, now of Columbia University, in 1930 he calculated the effect of the magnetic field of the earth on cosmic ray particles, long before work on this problem was undertaken in America. Professor Arthur H. Compton, who called him to the University of Chicago, entrusted to him the planning of a large part of the extensive ray work done at that institution.
>
> At Cornell, Dr. Rossi will develop cosmic ray research, and will work closely with Dr. Bethe and Dr. Robert F. Bacher in nuclear physics and with Dr. Lyman G. Parratt in x-rays. He will also collaborate with Professor Peter J. W. Debye, who joined the faculty as head of the department of chemistry on July 1.
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> In 1938 Dr. Rossi married Miss Nora Lombroso, granddaughter of Lombroso, the well-known Italian criminologist. They will establish their residence in Ithaca in time for the fall opening of the university.

SCIENTIFIC NOTES AND NEWS

The honorary degree of doctor of science was conferred on Dr. L. O. Grondahl, director of research and engineering of the Union Switch and Signal Company, Pittsburgh, Pa., at the commencement exercises of St. Olaf College, Northfield, Minn. Dr. Grondahl is an alumnus of the college.

Dr. Gustav Egloff, director of research for the Universal Oil Products Company, was awarded the degree of doctor of science at the commencement exercises at the Armour Institute of Technology in recognition of "his outstanding contributions in the field of petroleum refining."

According to *Nature* the Franqui Prize of half a million francs has been awarded by the Franqui Foundation Committee to Dr. Pierre Nolf, professor of pathology and therapeutics at Liège, for his contributions to science.

Dr. H. Vincent, professor at the Collège de France, formerly inspector-general of the Health Service of the French Army, has been elected vice-president of the Paris Academy of Sciences.

At the recent meeting in New York City of the American Society of Clinical Pathology, Dr. A. V. St. George, of New York, was inducted into the office of president for the coming year. The following officers were elected: *President-elect,* Dr. J. L. Lattimore, Topeka, Kans.; *Vice-president,* Dr. Ralph G. Stillman, New York City; *Executive Committee,* Dr. L. W. Larson, Bismarck, N. D.; Dr. C. H. Manlove, Portland, Ore.; *Board of Censors,* Dr. R. F. Peterson, Butte, Mont.; Dr. L. C. Todd, Charlotte, N. C.; *Board of Registry,* Dr. L. G. Montgomery, Muncie, Ind.; Dr. I. Davidsohn, Chicago. The Gold Medal for excellence in the scientific exhibit was awarded to Dr. John Eiman and Dr. Charles G. Grosscup for their exhibit on "Fundamental Factors Governing the State of Hydration of the Body in Health and Disease."

At the forty-third annual meeting of the American Society for Testing Materials on June 25, Dr. William M. Barr, chief chemical and metallurgical engineer of the Union Pacific Railroad Company, was elected president; Herbert J. Ball, vice-president, and Roger C. Griffin, Dr. Paul D. Merica, Jerome Strauss, Stanton Walker and C. H. Fellows, members of the executive committee.

Dr. Arthur S. Gale, of the University of Rochester, has been made dean emeritus of the physical sciences.

Dr. Albert P. Mathews, since 1918 Andrew Carnegie professor of biochemistry in the College of Medicine of the University of Cincinnati, retired on July 1. He has been succeeded by Dr. Milan A. Logan, assistant professor of biochemistry at Harvard University.

Dr. C. W. Metz, member of the staff of the Carnegie Institution of Washington, has been appointed professor and head of the department of zoology at the University of Pennsylvania. He succeeds Dr. C. E. McClung, who retired at the close of the academic year.

Dr. Paul C. Mangelsdorf, vice-director of the

Texas Agricultural Experiment Station, has been appointed professor of botany at Harvard University and assistant director of the Botanical Museum. Dr. Sheldon C. Reed, lecturer in genetics at McGill University, has been appointed instructor in biology.

DR. THOMAS P. COOPER, dean of the College of Agriculture of the University of Kentucky and director of the Experiment Station, has been made acting president of the university. Dr. Cooper will divide the time between his office in the experiment station and the president's office.

DR. DUGALD E. S. BROWN, assistant professor of physiology at the New York University College of Medicine, has been appointed professor and head of the department of physiology of the College of Dentistry.

DR. WILLIAM CRAMER, British delegate to the International Cancer Congress at Atlantic City last September and for over twenty-five years a member of the Imperial Cancer Research Fund, London, has joined the staff of the Barnard Free Skin and Cancer Hospital in St. Louis.

DR. H. MARK, formerly of the University of Vienna, has been appointed professor of organic chemistry at the Polytechnic Institute of Brooklyn. He will direct research in the field of high molecular weight compounds. During the year 1940–41, he will lecture on the physical aspects of organic chemistry and on the chemistry of rubber.

DR. PAUL V. MCKINNEY, senior fellow in the work of the Texas Gulf Sulphur Company at the Mellon Institute of Industrial Research, has been appointed director of research of the Neville Company, Pittsburgh, Pa. He will be engaged in a study of the production of synthetic resins and organic chemicals. The Neville Company is doubling the space devoted to research.

DR. A. E. ALEXANDER, industrial fellow at the Mellon Institute, Pittsburgh, has left to take charge of the Bureau of Natural Pearl Information, New York City. This gem and pearl testing laboratory is supported by a group of New York retail and wholesale jewelers.

DR. GRIFFITH C. EVANS, professor of mathematics at the University of California, has been appointed a member of the National Research Council in the division of the physical sciences, as a representative of the American Mathematical Society. The appointment was effective on July 1 and is for a three-year term.

THE Rockefeller Foundation has renewed a grant of $3,000 a year for three years to Duke University in support of the study of the physical chemistry of proteins by Dr. Hans Neurath, of the department of biochemistry of the School of Medicine.

THE Committee on Scientific Research of the American Medical Association has awarded grants to Dr. Herman Kabat and to Dr. Charles F. Code, both of the department of physiology of the University of Minnesota, the former for an investigation of the nervous component in traumatic shock, and the latter in aid of studies on the possible slow absorption of injected desoxycorticosterone from a mixture with beeswax. A final grant has been made to supplement an assignment made a year ago to Dr. Owen H. Wangensteen, professor and head of the department of surgery of the hospitals of the University of Minnesota, to continue research relating to the physiologic rationale of operations performed for the relief of duodenal and gastric ulcer. Dr. Howard Curl, assistant professor of anatomy at the University of Tennessee, has received a grant for a roentgenological study of the normal gall bladder.

JAMES F. WILSON, professor of animal husbandry at the University of California, sailed on July 20 for Australia, where he will spend a six months' leave of absence in studying wool production. Before leaving he was presented by the California Wool Growers Association with a set of luggage, "in appreciation of twenty years of service" to the industry.

DR. THOMAS J. LEBLANC, of the College of Medicine of the University of Cincinnati, and Dr. Elliston Farrell, of Long Island Medical College, with a number of their students are attending the six weeks summer school of the Puerto Rico School of Tropical Medicine.

AT the Conference on Nuclear Physics to be held at Indiana University to celebrate the opening of the new Physics Building, Swain Hall, on Friday and Saturday, October 25 and 26, special lectures will be given by Professors H. A. Bethe, Cornell University; Gregory Breit, University of Wisconsin; Lee A. DuBridge, University of Rochester, and I. I. Rabi, Columbia University.

DR. OSCAR RIDDLE, of the Carnegie Institution Station for Experimental Evolution at Cold Spring Harbor, N. Y., gave an address on "Hormones" before the Summer Science Conference at Syracuse University on July 18.

THE Genetics Society of America will hold a meeting at Woods Hole, Mass., on August 29 and 30. Summer meetings have been held annually at the Marine Biological Laboratory since 1934, with the exception of last year, when many of the members were attending the seventh International Congress of Genetics at Edinburgh. A clam-bake will be held on the evening of the twenty-ninth. Dr. Leon J. Cole is president of the society and Dr. E. W. Lindstrom is secretary-treasurer.

A MEETING of the Eastern Division of the American Philosophical Association will be held at the University of Pennsylvania on December 26, 27 and 28. Following the meeting there will be a symposium on "Science and Values" held in conjunction with the meeting of the American Association for the Advancement of Science.

THE regular summer meeting of the Pennsylvania Academy of Science is to be held at Gettysburg on August 9 and 10. Field trips to points of scientific interest in the vicinity are planned. Information can be obtained from the secretary of the society, Dr. V. Earl Light, Lebanon Valley College, Annville.

IN connection with the national defense program the U. S. Civil Service Commission is endeavoring to secure well-qualified metallurgists and metallurgical engineers for employment in the Federal Government. Examinations have been announced to fill these positions, covering six grades, with salaries ranging from $2,000 for the junior grades to $5,600 for the principal grades. Applications must be filed not later than August 22. Competitive examinations to fill the position of civil engineer cover four grades, with salaries ranging from $2,600 a year for the assistant grade to $4,600 a year for the senior grade. Applications should be on file at the Washington office of the commission not later than August 29. Further information as to the requirements for the various grades and application forms may be obtained from the Secretary of the Board of U. S. Civil Service Examiners at any first- or second-class post office, or from the U. S. Civil Service Commission, Washington, D. C.

THE Armour Institute of Technology and the Lewis Institute of Chicago were consolidated on July 24 under the name of the Illinois Institute of Technology. Henry T. Heald, who has been for two years head of the Armour Institute, was elected president. James D. Cunningham, chairman of the board of the Armour Institute, was named chairman of the board; Alexander D. Bailey, chairman of the trustees of the Lewis Institute, was elected vice-chairman.

THE National Cancer Institute, of the National Institute of Health of the U. S. Public Health Service, announces the establishment of *The Journal of the National Cancer Institute* as the official organ of the institute. The new journal, which will be issued bimonthly, will contain articles by the members of the staff on the various lines of cancer research work carried on by the institute. The first issue will include papers on the federal cancer control program, approaches to cancer research, the effect of various hydrocarbons in producing tumors in mice and studies on normal and cancerous tissues. The journal will be sold by the Superintendent of Documents, Government Printing Office, Washington, D. C. It will be distributed free to a limited number of medical schools, to workers in the field of cancer research, to research institutes interested in cancer, to a limited number of surgeons, as well as to certain government depositories and to journals making suitable exchanges.

IN connection with the celebration of the fiftieth anniversary of the University of Chicago, which begins on October 1, culminating in an academic festival in September, 1941, thirty-one learned societies, having together more than 15,000 members, will meet at the university. Dr. Frederic Woodward, vice-president emeritus, is director of the celebration. Among the first of the societies to meet in Chicago are the Clinical College of the American College of Surgeons and the International Anesthesia Research Society, from October 21 to 25. The American Association of Anatomists will meet from April 9 to 11, 1941.

BARLEY FIELD DAY, sponsored by the College of Agriculture of the University of Wisconsin, was held on July 15. Over two hundred visitors representing all phases of the barley handling, selling, malting, brewing, distilling and food industries were in attendance. The morning was spent in inspecting the barley breeding and experimental work on the University Farms. A picnic luncheon furnished by the Malt Research Institute and the United States Maltsters Association was served at noon, followed by a discussion of the responsibility of the Agricultural Experiment Station in coordinating agricultural research with the industrial use of farm products by Dr. Chris. L. Christensen, dean and director of the Wisconsin College of Agriculture and the Wisconsin Agricultural Experiment Station. This was followed by a discussion of the barley breeding program by Professor H. L. Shands and the history of barley improvement in the state by Professor B. D. Leith, both of the University of Wisconsin. The afternoon was spent in inspecting barley test plots and other experimental work. Those interested were given an opportunity to visit the experimental malting laboratory in the Agronomy Building.

THE first instalment of Central American collections of mammals, reptiles and invertebrate animals obtained on an expedition for the British Museum conducted by Ivan T. Sanderson, of Belize, British Honduras, has been received for deposit at the Field Museum of Natural History, Chicago, for the duration of the war. Mr. Sanderson, formerly of Cambridge, England, has conducted expeditions in many parts of Africa and the West Indies. At his request, identification of some of his material will be undertaken at the museum and some division of the collections will ultimately be made between the Field Museum and the British Museum.

DISCUSSION

NATIVE AND INTRODUCED LAND PLANARIANS IN THE UNITED STATES

The land planarians characteristically inhabit humid forests in the tropical and subtropical zones of the earth where hundreds of species exist. In his classical monograph[1] von Graff listed 348 species (some, however, probably synonyms) and probably two hundred additional species have been described since that time. As great areas of the tropics remain unexplored with regard to this group of flatworms, it seems reasonable to suppose that the undescribed species at least equal the described ones in number.

The introduction of tropical land planarians into the north temperate zone with tropical plants appears inevitable, yet until recently only one species was known to have succeeded in establishing itself. This is the familiar *Bipalium kewense* Moseley, discovered in 1878 in the greenhouses of the Kew Gardens, near London. This animal is common in greenhouses and conservatories throughout Europe and the United States and also occurs in nature in a variety of tropical habitats, as Brazil, New Zealand, Australia, Samoa, Fiji, Madeira, Hawaii, China and Japan. Its original home is unknown, but may be inferred to have been somewhere in the Indo-Malay region, since the family Bipaliidae centers there. Specimens received for identification from the U. S. National Museum show that *Bipalium kewense* has become established out-of-doors in the West Indies and southern Florida.

Occasionally other exotic land planarians appear in greenhouses, but none is known to have persisted for any length of time. Thus several specimens of a species of *Desmorhynchus* (possibly from Madagascar) were taken in 1914–1916 in greenhouses of the U. S. Department of Agriculture in Washington, D. C.

In view of the general failure of exotic land planarians to maintain themselves in the north temperate zone, even in greenhouses, it is rather surprising to find that these animals have in recent years established themselves in Californian gardens and appear to be flourishing. Specimens of three different species have been received to date.[2] These comprise two species of *Geoplana* and one *Bipalium*. One of the *Geoplanas*, a small black species, turns out to be *G. mexicana* Hyman, 1939,[3] twice found at the Texas border on shipments of flowers from Mexico. Hence this species has been introduced into California from Mexico. The other *Geoplana*, a larger bluish-black form, and the *Bipalium*, light brown with a dark brown mid-dorsal stripe, do not appear to coincide with any described species. All three species are fully mature and are undoubtedly reproducing sexually in their adopted home. This point is of especial interest, since in general tropical land planarians when introduced into cooler climates fail to mature sexually and hence can not persist unless they are capable of some mode of asexual reproduction. The latter appears to explain the persistence of *Bipalium kewense*, since this species also has never been found with sex organs in temperate regions. The fact that the California forms are able to mature leads one to suspect that they are native to some adjacent, not fully tropical region, as Mexico or Central America.

Genuinely endemic land planarians do, however, occur in the north temperate zone; curiously enough, all these belong to the family Rhynchodemidae, and nearly all to the genus *Rhynchodemus*.[4] About 15 species have been described in Europe,[5] but the endemicity of some of these may be questioned, especially those known only from the Riviera, where there are many introduced plants. In the United States, two endemic rhynchodemids have been reported to the present time. These are *Rhynchodemus sylvaticus* (Leidy), 1851[6] and *R. atrocyaneus* Walton, 1912.[7] The former, small, slender, grayish with two dark stripes and with pointed head bearing a pair of large eyes, has been reported from Rhode Island, Pennsylvania, and Ohio, under pots and boards in gardens and meadows, and under logs and bark in woods. Apparently not uncommon in former years, this species seems not to have been collected in the last twenty years, and attempts to obtain specimens from Philadelphia, the type locality, have so far proved futile.[8] Of *R. atrocyaneus* nothing was known but the original description, which states that two specimens were found at Gambier, Ohio, 20 cm long and of a uniformly dark blue color. I have come into possession of a set of serial sections of this species found among the effects of Dr. Walton,[9] and these yield some additional information but unfortunately the specimen is sexually immature.

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[1] “Monographie der Turbellarien. II. Tricladida Terricola.” 1899.

[2] Kindly sent by Dr. M. W. de Laubenfels, Pasadena, and John L. Mohr, Berkeley.

[3] *Proc. U. S. Nat. Mus.*, 86: 425.

[4] *Microplana* has recently been shown to be a synonym of *Rhynchodemus* (Schneider, *Zool. Jahrb. Abt. System.*, 67: 179).

[5] Recently listed by Arndt, *Zoogeographica*, 2: 375.

[6] *Proc. Acad. Nat. Sci. Phila.*, 5: 239, 289; 10: 171.

[7] Science, 25: 732.

[8] Dr. J. Percy Moore kindly tried to find some specimens for me.

I have now to report the finding in woods of the Appalachian Mountains of a new endemic rhynchodemid. To date three specimens have come to hand,[10] collected in Maryland, Virginia, and West Virginia, respectively. All three are at or near sexual maturity, and study of the copulatory apparatus in serial section has shown that the animal belongs to the genus *Diporodemus* Hyman, 1938.[11] This genus differs from *Rhynchodemus* in that in addition to the usual common genital pore opening in the midventral line there is a female or vaginal pore to one side of the median line by which the copulatory bursa opens to the exterior. I established this genus for a species from Yucatan, Mexico. Since then a second species of the genus has been found on Barro Colorado Island, Canal Zone,[12] and now the Appalachian form is the third member. All three species are practically identical in external appearance. They are black or brownish black, plump, cylindroid and about 15 mm in length; the Panamanian and Appalachian species are further alike in that the eyes are degenerate, detectable only in sections, and the creeping sole continues onto the ventral surface of the head as a glandular cleft, probably acting as an adhesive organ in food capture. The Yucatan and Appalachian species have also in common a pair of longitudinal sensory tracts on the cephalic ventral surface.

A complete account of these endemic and introduced land planarians will be published elsewhere.

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CONCERNING PURE CULTURES OF SPIRILLUM

ALTHOUGH bacteriologists have long been interested in spiral bacteria, very few workers have reported success in the isolation of pure cultures. Esmarch,[1] Beijerinck,[2] Kutscher,[3] Bonhoff,[4] Dimitroff[5] and Giesberger[6] have described methods by which they were able to isolate several species from water and feces.

Several months ago, the writer wished to procure some species of this genus for cytological study, but after considerable correspondence, found that such cultures are not available. It now seems probable that all or most of the pure cultures isolated by earlier investigators have been lost. *Rhodospirillum rubrum* (Esmarch) Molich and *Spirillum virginianum* Dimitroff were obtained from the American Type Culture Collection. The cells of these species are rather small, however, and not well suited for cytological study. Since pure cultures could not be obtained from culture collections, isolation of the desired species from original sources was accomplished.

This note is written to correct a general impression that the isolation of pure cultures of Spirillum is a difficult matter. My experience has been that several species are readily isolated from raw cultures by simple routine methods employed for other groups of bacteria. Suitable raw cultures must be obtained by enrichment methods, but this is not difficult since most surface waters appear to contain a variety of species of this genus.

Several culture media were tested for enrichment, but none was found more satisfactory than hay or other plant infusions. Decaying cultures of fresh water algae usually contain many spiral bacteria. Spiral cells are rarely seen in the early stages of decomposition, but as the culture ages they become more and more abundant until, at times, the surface pellicle becomes a swarming mass in which they predominate. This peak period may be reached within a few days but generally requires from one to three weeks. Raw cultures are generally rather short lived.

During the swarming period, pure cultures are readily isolated by streaking out on the surface of beef extract peptone agar. The colonies appear promptly and are readily recognized by microscopic examination *in situ*. By this method the following species were isolated from creek and pond waters in the vicinity of Austin, Texas: *Sp. serpens* (Müller) Winter, *Sp. undula* (Müller) Ehrenberg, *Sp. tenue* (Müller) Ehrenberg, *Sp. itersonii* Giesberger. The most common species in this vicinity proved to be *Sp. serpens*.

Although rich raw cultures of *Sp. volutans* Ehbg. became available on two occasions, it was not possible to obtain pure cultures since no colonies developed on the streaked plates or in poured plates with semi-solid agar as the plating medium. The giant spiral cells of this species could be seen lying on the agar surface, but there were never any indications of growth or cell division.

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[9] Dr. H. I. Strohecker, of Kenyon College, Gambier, Ohio, kindly forwarded to me a box of slides of land planarians made by Dr. Walton.

[10] Sent for identification by the U. S. National Museum and collected by Dr. J. P. E. Morrison of that institution.

[11] "Fauna of the Caves of Yucatan," Carnegie Inst. Wash., Publ. No. 491.

[12] A collection of land planarians from Barro Colorado Island was kindly sent to me for identification by E. C. Williams, Jr., of Northwestern University; description in press.

[1] E. von Esmarch, *Centr. f. Bakt.*, 1: 225, 1887.

[2] M. W. Beijerinck, *Centr. f. Bakt.*, 14: 827, 1893.

[3] Kutscher, *Zeitschr. f. Hygiene*, 20: 46, 1895.

[4] Bonhoff, *Archiv f. Hygiene*, 26: 162, 1896.

[5] V. T. Dimitroff, *Jour. Bact.*, 12: 19, 1926.

[6] G. Giesberger, Delft thesis, W. D. Meinema, pp. 1–136, 1936.

There has been but a single claim for isolation of this species. Kutscher identified one of his pure cultures as *Sp. volutans* Ehbg., but his identification was questioned by Migula.[7] According to Migula, the organism isolated by Kutscher should be designated as *Sp. giganteum* (Kutscher) Migula. This has caused considerable confusion since many workers employed Kutscher's organism in their studies on the cytology and physiology of bacteria, and referred to the organism as *Sp. volutans*. The illustrations by these workers bear little or no resemblance to the true *Sp. volutans* Ehbg. There seems, therefore, no reason to believe that this species has yet been isolated.

A cytological study of the several species has been completed and will be published elsewhere. The pure cultures have been deposited in the American Type Culture Collection.

I. M. Lewis
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OXIDATION OF SULFANILIC AND ARSANILIC COMPOUNDS BY NASCENT HYDROGEN PEROXIDE

Ottenberg and Fox[1] have reported that colored products appeared following ultra-violet irradiation of dilute solutions of sulfanilamide. The blue-violet products seemed of particular interest. Fox, Cline and Ottenberg[2] as well as Rimington and Hemmings[3] emphasized that the formation of the blue derivative involves an oxidation of sulfanilamide, since the presence of oxygen is necessary for the formation of the blue-colored irradiation product.

Oxidation of sulfanilamide by chemical means to a blue product had not been accomplished, when Fox, Cline and Ottenberg published their article.[2] In the meantime I[4] have reported that, under certain experimental conditions, solutions of sulfanilamide treated with oxygen form hydrogen peroxide and a blue-violet compound which is reversibly reducible and oxidizable. The hypothesis was advanced that the formation of this blue-colored substance may be due to the influence of nascent H_2O_2. In further experiments being published in detail elsewhere it was found that nascent hydrogen peroxide as formed on autoxidation of hydrazine solutions (Gilbert,[5] Schales[6]), in presence of cupric ions oxidizes sulfanilamide promptly to blue-violet derivatives. These substances are reversibly reducible and oxidizable, and, when freshly formed, extractable with amyl and butyl alcohols and other organic solvents. They are comparatively stable in those solvents but unstable in water, losing extractability and changing color.

Among related compounds studied arsanilic acid behaves in a manner comparable with sulfanilamide. The blue-violet butyl alcoholic extracts obtained from sulfanilamide and arsanilate showed an absorption spectrum practically identical in shape (maximum absorption at about 590 mμ). The identity of the two blue compounds is probable. It would be expected that if these compounds had retained their characteristic side-chains there would be a greater difference in the absorption spectra. If the oxidation products are identical the side-chains must have been lost. It is suggested that therapeutically or toxically active derivatives formed *in vivo* also may lack the characteristic side-chains of the original substance.

Rosenthal and Bauer[7] recently published in this journal the extremely interesting observations that on oxidation of sulfanilamide by means of ultra-violet irradiation or ferric chloride and hydrogen peroxide the sulfonamide group is split off. My studies of the spectroscopical behavior of the blue oxidation products obtained from sulfanilamide and from atoxyl lead to a similar conclusion.

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SCIENTIFIC BOOKS

THE CALCULUS

Introduction to the Calculus. By Arnold Dresden. xii + 428 pp. New York: Henry Holt and Company. 1940. $3.40.

This book, as its title indicates, is designed as an introduction to the calculus, presumably for students of sophomore age. It is particularly noteworthy, inasmuch as it is the first serious attempt among American text-books to introduce the subject in a rigorous and logical manner. The first two chapters, about sixty pages, of the book, are devoted to the essentials of the theory of point sets and of continuous functions. From that point on the book treats in more or less standard order the usual topics of the differential and integral calculus, with the exception that the proofs are placed on a more rigorous footing. These proofs are not always given in complete detail. They are deliberately curtailed in order to keep the essentials clearly in focus. In some cases the parts omitted are included in the exercises. For example, the derivation of the formula for the derivative of a function of a function, left incomplete in most text-books, is here carried to a point so near completion that the student can fill in the details. The book does not entirely solve the logical difficulties of the teacher resulting from the necessity of a choice in the order of topics. In some cases forward references are necessary. Thus the "Law of the Mean" is used on page 92, while it is proved on page 117.

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[7] W. Migula, "System der Bakterien." Jena, 1900.

[1] R. Ottenberg and Ch. L. Fox, Jr., *Proc. Soc. Exp. Biol. and Med.*, 38: 479–481, 1938.

[2] Ch. L. Fox, Jr., J. E. Cline and R. Ottenberg, *Jour. Pharmacol. and Exp. Therap.*, 66: 99–106, 1939.

[3] Cl. Rimington and A. W. Hemmings, *Biochem. Jour.*, 33: 960–977, 1939.

[4] G. Barkan, *Proc. Soc. Exp. Biol. and Med.*, 41: 535–537, 1939.

[5] E. C. Gilbert, *Jour. Am. Chem. Soc.*, 51: 2744–2751, 1929.

[6] O. Schales, *Ber. Dtsch. Chem. Ges.*, 71: 447–460, 1938.

[7] S. M. Rosenthal and H. Bauer, Science, 91: 2369, 509, May 24, 1940.

The topics are concerned mostly with functions of one variable. There is, however, one chapter on double and triple integration. Also, partial differentiation is defined and used (in Chapter 4) to obtain the derivatives of functions defined implicitly. The book ends with two chapters on differential equations.

A problem which confronts the teacher of students who wish to make use of the calculus in the applied sciences is how to introduce the subject of integration early enough. The text under review solves it by introducing problems on inverse differentiation in with those on differentiation. The definite integral is introduced in Chapter 12, in characteristic fashion, with the proof that its defining limit exists for any continuous function! The author admits that the student, meeting the subject for the first time, might wish to omit such a proof. In fact, he points out that the traditional course "can be extracted from the book by omitting the proofs of theorems." In spite of the rigorous point of view, a lively and interesting style is maintained. Witness the term "principle of the fly-catcher."

The reviewer regrets that the very useful exact remainder theorem for Taylor's theorem (expressing the remainder as a definite integral) is omitted here as in most standard text-books. He also feels that the utility of the book would be slightly increased if the statement of theorems were italicized.

This book presents the calculus as the teacher would like to present it to his classes, in logical order. We have hitherto assumed in this country that this most pleasant method of lecturing was not the most efficient way of teaching, that maximum enjoyment for the instructor might mean minimum enjoyment for the mediocre student. The author believes otherwise, that the present type of treatment should increase the student's enjoyment as well as his power to use the material. He bases his belief on his own experience as a teacher in this country, and on his acquaintance with young Europeans of the age of American sophomores. It is devoutly to be wished that he is right and that others who use the book will make similar findings.

D. V. WIDDER

IMAGE TRANSMISSION

Television—the Electronics of Image Transmission. By V. K. ZWORYKIN and G. A. MORTON. ix + 646 pp. New York: John Wiley and Sons, Inc. 1940.

THIS book is designed to condense and summarize in a readily accessible form the extensive literature which has already grown up in the field of television. The subject-matter is divided into four main sections. The first part deals with the fundamental processes and phenomena upon which the art of television is based. The second part discusses the general principles of television and the necessary relationships between the optical image and the transmitted radio image. The third portion deals with the individual components of the complete television system as devised in the RCA laboratories, and the fourth portion describes the equipment of the RCA-NBC television project. The first two sections will be of most interest to the general scientific reader, for in these parts are contained all that is necessary for a detailed understanding of the science of television as practiced to-day. The other two sections will be useful to those having an interest in the finer details of the subject.

The authors are to be particularly congratulated upon the extremely clear and concise exposition of the fundamental physical principles which occupy the first five chapters of the book. These chapters cover the emission of electrons from solids, fluorescent materials, electron optics and modern high-vacuum technique in the short space of 150 pages. Most physicists could read these pages with profit.

C. G. MONTGOMERY

THE BARTOL RESEARCH FOUNDATION
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REPORTS

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

MECHANICAL engineers throughout the United States and Canada are observing this year the sixtieth anniversary of the founding of their professional organization, the American Society of Mechanical Engineers, which to-day has 15,000 members and maintains headquarters in New York City and 71 school sections in various industrial areas. The story of the growth of the society coincides with the period in American industrial history in which the greatest mechanical developments have occurred, much of which have been made possible through the efforts of the society and its members, whose names would fill many pages. Their achievements cover a myriad of fields, chief of which are air conditioning, aeronautics, electric machinery, engineering research, metals, fuels, hydraulic turbines, internal-combustion engines, machine tools, naval improvements, ordnance material, petroleum, plastics, printing presses, pumps, railroads, scientific management, steam power, textiles and woodworking machinery.

It was on April 7, 1880, that 80 mechanical engineers organized the American Society of Mechanical Engineers, which had an initial membership of 189. As early as then, the founder members promulgated the present objectives of their engineering organization, which are to promote the art and science of mechanical engineering and the allied arts and sciences; to encourage original research; to foster engineering education; to advance the standards of engineering; to promote the intercourse of engineers among themselves and with allied technologists, and severally and in cooperation with other engineering and technical societies to broaden the usefulness of the engineering profession to industry, community and world. As officers of the new society, there were elected by those present a representative group of engineers, headed by President Robert Henry Thurston, pioneer educator in mechanical engineering. In 1883, Frederick Remsen Hutton, professor of mechanical engineering at Columbia University, became the first regular secretary, a part-time position that he held until 1906.

The early history of the society reflects the earnest endeavors of its slowly increasing membership to organize for the purposes enunciated by the founder members. Meetings were held, papers and discussions were presented and published and standards for material specifications and codes for recommended practice in a number of fields of testing were undertaken. Shortly after the turn of the century, a new spirit began to manifest itself in the organization. The rapid spread of membership throughout the country and the realization by engineers in many industrial centers that great benefits would result from local organizations culminated in 1904 in the establishment in Milwaukee of the first local section of the society. This movement led to the organization of others, until to-day there are 71 such groups in the United States and Canada.

The splendid gift by Andrew Carnegie of an engineering societies building in New York City, dedicated in 1906, gave impetus to widening influences and brought with it a realization that greater obligations had been placed upon the society. With the occupancy of the new headquarters in the building and the appointment of Calvin W. Rice as full-time secretary, a second period of growth began.

This second period of development was marked by the increase in the society's activities and their diversity, and a rapid growth of membership. Cooperation with other engineering bodies, in this country and abroad; more frequent meetings; the broadening of the field of professional interest; realization of the obligation of service in civic and social progress; increased activity in standardization, research, codes of recommended practice and safety; greater activity in local sections and student branches, the first of which was authorized in 1908 and to-day number 117 with 6,500 student members; and more extensive and more diversified publications have been some of the fruits of this growth. In 1919, from a recognition of the ever-broadening technical interests of the society's members came the 16 professional divisions under whose auspices the professional work of the society in the various branches of mechanical engineering is now carried on. National meetings, each devoted to a single subject but drawing participants from the country at large, were instituted to augment the more general meetings of the society in various cities in which all divisions take part and the local meetings, which are arranged entirely by local sections.

In this period were begun certain technical activities which have materially benefited industry and the general public. Boiler explosions are a rarity since the society undertook to prepare and continually revise a "boiler code," which has become law and the standard for 24 states, the Hawaiian Islands, Panama Canal Zone, two Canadian provinces and 18 cities, in the design, construction and operation of boilers and pressure vessels. As a further means of safeguarding human life, the society has sponsored other safety codes, such as those for elevators, already adopted in several states and a score of cities, hoists, compressed-air machinery, pressure piping and conveying equipment. To determine whether an engine or machine is delivering its rated horsepower or capacity, the society has set up for the guidance of engineers "power test codes" to be used in testing compressors, heaters, internal-combustion engines, fuels, pumps, steam engines and turbines, refrigerating systems, steam locomotives and other auxiliary apparatus.

At the beginning of the period, the society added research to the list of its technical activities. Unaffected by commercial considerations or influence and interested primarily in the advancement of knowledge of mechanical engineering, the society has sponsored research on fluid meters, feedwater studies, management, cutting of metals, mechanical springs, effect of temperature upon properties of metals, woods of the world, gearing, bearings, hydraulics, steam tables, elevators, welding and lubrication. Another important function of the society is its service to the engineering profession and to industry in the sponsorship of dimensional standardization in the field of mechanical engineering, beginning with pipe threads and including bolts, nuts, rivets, screw threads, couplings and hundreds of other items. This last activity has made possible mass production in the automotive and other fields, which in turn have provided the general public with cheaper automobiles, household appliances, typewriters, airplanes and similar articles.

The pattern of the third period of the society's development, now in progress, appears to be characterized by a growing concern for the education and training of the engineer and his professional development and status, for engineering as one of the learned professions, and for the opportunities and obligations of public service, which involve economic and sociological as well as ethical, educational and financial considerations. The vital problems, personal, professional and national, raised by the world-wide depression of the 1930's, have already influenced and given direction to this third period, which is roughly coincident with the secretaryship, held since the death of Dr. Rice in 1934, by C. E Davies.

To enhance the status of the engineer, the American Society of Mechanical Engineers is maintaining its high technical and cultural standards for entrance to the society; cooperating with educational institutions in the maintenance of high standards of engineering education; requiring a high standard of ethical practice by members of the society; aiding in the adoption of a high standard of attainment for the granting of the legal right to practice professional engineering; fostering among engineering students the study of philosophy and history, tradition and achievements, duties and social functions of the engineering profession; encouraging the personal and professional development of young engineers; and supporting activities looking to the increased employment of engineers and seeking new opportunities for engineering service. The usefulness of the organized engineering profession is being increased by cooperating with other engineering and technical societies; encouraging a high standard of citizenship among engineers; encouraging engineers to participate in public affairs; cooperating with governmental agencies in engineering matters; and fostering a better understanding by the general public of the value of engineering as evidenced by the achievements of engineers.

L. F. Z.

SPECIAL ARTICLES

UNIFORMITY OF THE PAIN THRESHOLD IN MAN[1]

THE aim of these studies was to ascertain: To what extent the variable distress experienced by different persons during similar pain stimuli is dependent upon differences in perception (the pain threshold), and to what extent on differences in reaction to pain.

Earnest efforts in the past[2] have been made to deal with this problem, but a definite answer has been delayed because of the absence of an accurate method of ascertaining the pain threshold. A suitable method has been described by Hardy, Wolff and Goodell,[3] who have made accurate measurements of the pain threshold and have demonstrated its stability in three subjects. The day-to-day variations over a period of almost a year, despite varying moods and vicissitudes, caused a deviation from the mean no greater than ± 12 per cent. However, the pain threshold may be altered by various factors. Thus, pain in one part of the body raises the pain threshold in other parts. Also, chemical agents such as acetylsalicylic acid and the opiates are capable of appreciably raising the pain threshold, on which fact rests part of their therapeutic usefulness.[4]

To investigate the variability of the pain threshold in a population under average conditions of well-being, 150 subjects of different ages and both sexes were tested. The results of this more comprehensive study of the pain threshold form the topic of this communication.

METHOD

The apparatus[3] for measuring the pain threshold is shown diagrammatically in Fig. 1. The light from a 1,000-watt lamp was focussed by a condensing lens through a fixed aperture 1.8 cm. in diameter onto the blackened forehead of the subject for exactly three seconds. The intensity of the radiation was controlled by means of a rheostat. The subject reported on his sensation, and if no pain was experienced the procedure was repeated every 30 to 60 seconds until he just felt pain at the end of the exposure. The intensity of heat at this point was measured by a radiometer and considered to be the minimum stimulus for pain. This threshold pain was easily recognized, even by untrained subjects. The sensation was that of heat finally "rising" or "swelling" to a distinct sharp stab of pain at the end of the three-second exposure.

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[1] From the Russell Sage Institute of Pathology in affiliation with the New York Hospital and the Departments of Medicine and Psychiatry, Cornell University Medical College, New York, N. Y.

[2] E. Libman, *Jour. Am. Med. Asn.*, 102: 335, February 3, 1934.

[3] J. D. Hardy, H. G. Wolff and H. Goodell, *Jour. Clin. Invest.*, 19: 649, July, 1940.

[4] H. G. Wolff, J. D. Hardy and H. Goodell, *Jour. Clin. Invest.*, 19: 659, July, 1940.

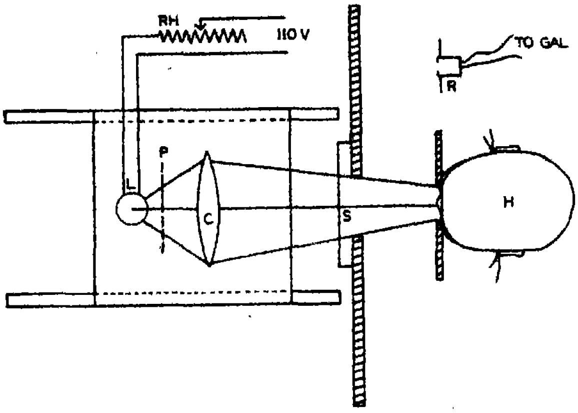

FIG. 1.

RESULTS

Observations were made on 150 subjects. A few subjects were repeatedly examined at intervals of several days and weeks. There were 324 observations on 150 subjects. The data were considered on the basis of a single value for each subject, which was the average of all observations made on the subject. These individuals were of both sexes, of various ages and of widely different social and educational experience. They were individuals who at the time of examination had no pain, infection or gross metabolic disturbance. Each subject was asked to express an opinion about his own pain sensitivity. The average amount of energy necessary to produce just the beginning of pain at the end of the three-second exposure, that is, the pain threshold, was 0.206 gm.cals/sec./cm². The range of threshold readings was from 0.173 gm.cals./sec./cm.² to 0.232 gm.cals./sec./cm². The distribution of results is shown in Fig. 2. The average of these data in absolute value is 10 per cent. lower than the average obtained by Hardy, Wolff and Goodell on three carefully studied subjects. The measurement of energy in this intensity range in absolute value is a difficult technical procedure and the agreement of the observations made with an entirely different apparatus may be considered adequate. The series of pain-threshold determinations when plotted produced a bell-shaped curve with −16 to +13 per cent. as the limit of deviation from the mean, and with 91 per cent. of all determinations falling within ± 8 per cent. The standard deviation for the group was ± 1 per cent.

There were wide variations in the expression of personal estimates of pain perception, such as "exquisitely sensitive to painful stimuli," "average" and "very insensitive to pain." With few exceptions, however, there was no relation between the personal estimation of hypersensitivity or hyposensitivity and the pain threshold as measured here.

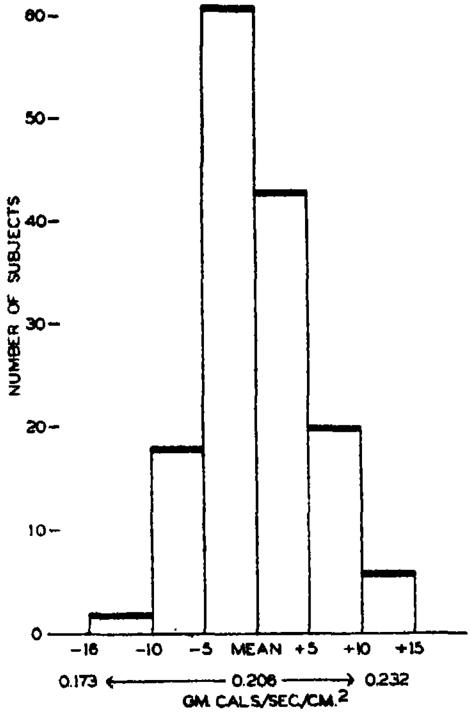

FIG. 2.

To test further whether or not sleep loss would affect the stability of the pain threshold, hourly and sometimes half-hourly observations were made upon four subjects (authors) over a span of 24 hours. A total of 103 observations (each consisting of 2 independent measurements) was made. During this time the subjects carried out, in so far as possible, their usual daily activities, including eating. Sleep, however, was completely avoided. All drugs, including coffee and tobacco, were omitted except three hours before the experimental period ended. At this time three of the subjects took a cup of coffee each, whereas one took no coffee.

Throughout the 24 hours each of the subjects experienced wide variations in both the degree of wakefulness and in emotional state. The former ranged from alertness and effectiveness to weariness, drowsiness and lethargy. The emotional states ranged from good humor, calmness and placidity, elation and gayety, to indifference, apathy, dullness, restlessness, irritability and tension.

The 150 pain threshold values again varied but slightly from the mean threshold value as determined for the four subjects throughout the 24-hour period. This mean value was 0.210 gm.cals./sec./cm.², the range being from 0.193 gm.cals./sec./cm.² to 0.227

gm.cals./sec./cm². The limits of deviation from the mean were ± 8 per cent., and 95 per cent. of all the determinations fell within ± 5 per cent. of the mean. No difference was noted between those who, toward the end of the experiment, drank coffee and the one who did not. Results are shown in Fig. 3. Macht,[5] using another method, obtained similar constant values for the pain threshold throughout 26 hours.

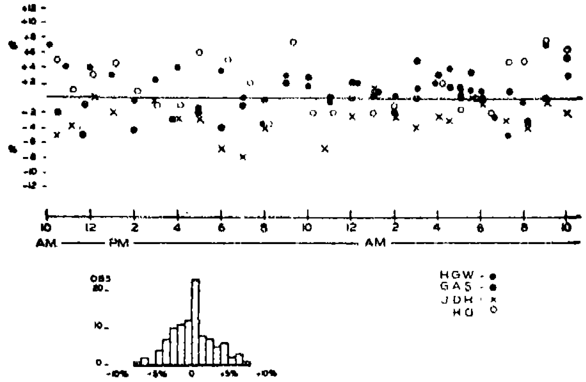

FIG. 3.

From these data it is inferred that the pain threshold in man is relatively stable and uniform. In contrast to this uniformity in the threshold for the perception of pain are the wide individual variations which occur in the reaction to pain. This latter seems to be dependent upon individual experience and attitude.

CONCLUSIONS

(1) Pain threshold in 150 persons of different ages and of both sexes was approximately the same, 0.206 ± 0.03 gm.cals./sec./cm². The standard deviaiton for the group was ± 1 per cent., the same as previously observed for individual subjects.

(2) Pain threshold could not be correlated with the subject's estimates of his or her sensitiveness to pain.

(3) Pain threshold was independent of sex.

(4) Pain threshold is uniform throughout the 24-hour day and not affected by feelings of lethargy, tension and over-irritability, nor lack of sleep for a 24-hour period.

(5) Individual reactions to pain are not the result of individual variations in pain threshold.

GEORGE A. SCHUMACHER
HELEN GOODELL
JAMES D. HARDY
HAROLD G. WOLFF

THE UTILIZATION OF L-GLUCOSE BY MAMMALIAN TISSUES AND BACTERIA

EMIL FISCHER observed in 1890 that l-glucose was not fermented by brewer's yeast.[1] Since no further work has been reported on the ability of other cells to metabolize this sugar, mammalian tissues and bacteria were examined in this respect.

The l-glucose was prepared by the reduction of l-gluconic lactone, following the method of Emil Fischer.[1] For the preparation of l-gluconic lactone the method of Kiliani,[2] with slight modifications, was used. The crystalline anhydrous l-glucose obtained had a specific rotation of $(\alpha)_D = -52.5°$.[3]

Experiments were carried out manometrically on surviving tissue slices of the rat. The respiration of the gray matter of brain and the aerobic and anaerobic glycolysis of Sarcoma 39 were measured according to Otto Warburg's method.[4] It was found that l-glucose is neither oxidized nor fermented by surviving tissue slices of rat brain or Sarcoma 39; nor does it affect the oxidation or fermentation of d-glucose by these tissues.

L-glucose is not metabolized in the animal body, as shown by the following experiment: A rat was injected intravenously with a 5 per cent. solution of l-glucose equivalent to 1 gram of l-glucose per kilogram of body weight. The amount of l-glucose excreted in the urine was determined polarimetrically. Approximately 85 per cent. of the l-glucose was excreted within twenty-four hours.

B. coli communis (Escherichia) and *Bacterium aerogenes* were cultured in a synthetic salt medium to which was added 1 per cent. d-glucose and 1 per cent. l-glucose, respectively. Both bacteria grew on d-glucose, but neither showed any appreciable signs of growth on l-glucose.

In another experiment the synthetic salt medium was replaced by Dunham's peptone solution. Bromothymol blue was added to indicate changes in pH, and inverted small tubes (Durham tubes) were used for collecting gas. The two test cultures (*B. coli* and *B. aerogenes*) grew well in the control tubes containing d-glucose, but no growth was observed in the tubes containing l-glucose. Acid and gas were formed in twenty-four hours by both bacteria in the presence of dextrose, but no acid or gas by either in the presence of l-glucose.

SUMMARY

The utilization of l-glucose by rat tissues and *B. coli* and *B. aerogenes* was studied. There was no evidence that l-glucose was metabolized by either mammalian or bacterial cells.

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[5] D. I. Macht, N. B. Herman and C. S. Levy, *Jour. Pharmacol.*, 8: 1, 1916.

[1] E. Fischer, *Berichte*, 23: 2611, 1890.

[2] Kiliani, *Berichte*, 55: 100, 1922; 58: 2349, 1925.

[3] The l-glucose was prepared by Edith L. Anderson, working under a grant from the Banting Research Foundation.

[4] O. Warburg, "The Metabolism of Tumours," Constable and Company, London. 1930.

The author wishes to express his gratitude to Dr. E. Anderson for the preparation of the l-glucose and to Professor W. L. Holman, of the department of bacteriology of this university, for carrying out the bacterial tests.

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TULAREMIA ENDOTOXIN

I obtained a strong tularemia endotoxin from Hamzabey and Ceylon strains which I had isolated from a brook during the investigations[1] of the tularemia epidemic in Thrace in 1937.

These strains were cultivated in plates containing blood and cystin media. These cultures were then emulsified in sterile distilled water, placed in flasks containing beads. These flasks were then put in tin boxes lined with cotton and incubated in 37° C. incubators for autolysis. The boxes were shaken thoroughly twice daily. The incubation lasted 45 days, during which time all the tularemia bacteria died. After the product was found completely sterile it was centrifugalized. The clear, sterile autolysite was then desiccated in vacuum in the presence of sulfuric acid. The dry endotoxin thus obtained was dissolved in sterile distilled water, having 50 mg of dry toxin in 1 cc. It was recentrifugalized. The tests made with the broth-colored solution gave the following results:

(1) White mice weighing 20 grams, injected intravenously with 0.3 cc of this solution (15 millig. of dry toxin) = (M. L. D.), died instantly with severe convulsions.

(2) The intraperitoneal injections of the same amount killed the mice within 24 hours.

(3) Guinea-pigs weighing 250–300 grams were injected 15 centigrams of dry toxin intraperitoneally, and they died within 24 hours with typical cries.

(4) The intracutaneous injections of 10–15 millig. of dry endotoxin caused a passing vasoconstriction at the site of injection.

(5) Repeated intravenous injections to rabbits showed the antigenic value of the endotoxin by the presence of a marked flocculation reaction. Moreover, it was found that the endotoxin produced titratable flocculation and precipitation reactions with the sera of persons who had previously had tularemia infection, as well as with those of guinea-pigs with chronic tularemia infection. These sera also neutralized the cutaneous vasoconstriction.

(6) The endotoxin does not contain hemolysins.

Finding it possible that this endotoxin can be used as a standard toxin in the standardization and control of tularemia antisera, and that the detoxicated toxin can be used for the prevention of the disease, I thought the publication of this work might be of some use to other workers in this field.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE THROMBOPLASTIN REAGENT FOR THE DETERMINATION OF PROTHROMBIN

For the satisfactory quantitative determination of prothrombin by my method,[1] a thromboplastin is required which is stable and has a high and uniform activity. Such an agent can readily be prepared as follows: a rabbit brain, from which the superficial blood vessels have been removed by stripping off the pia, is mascerated in a glass mortar under acetone. After several replacements of fresh acetone, a granular non-adhesive product is obtained which is dried on a small suction filter. The dehydrating process should not require more than 10 minutes and the acetone must not be acid (Eastman's Practical is satisfactory). As soon as the thromboplastin is free of acetone, it is put in a glass ampule which is evacuated by means of an oil vacuum pump for 3 minutes and then sealed in a gas flame. For convenience 0.3 gm material is put in each ampule. To prepare the emulsion, this amount of dry material is mixed with 5 cc of a freshly prepared 0.85 per cent. sodium chloride solution, incubated for 15 minutes at 50° C., and then allowed to stand until the coarse material is settled and a milky supernatant liquid is obtained. The presence of suspended material does not interfere with the test. Centrifugation often reduces the activity of the emulsion. The thromboplastin solution prepared in this manner will, according to the technique of my test, clot human plasma in 11 to 12½ seconds and rabbit plasma in 6 seconds. For research purposes no preparation which does not bring about coagulation in these periods should be employed.

Curiously, the dehydration of rabbit brain with acetone or with dioxan markedly increases the thromboplastic activity. There is at present no explanation for this finding. Whereas an emulsion of fresh rabbit brain clots human plasma in 16 to 25 seconds, the thromboplastin made by the acetone method brings about clotting in 11 to 12½ seconds. Dehydration with acetone, moreover, makes the product much more constant in potency. It seems, therefore, advisable to abandon the use of fresh brain, even though Souter, Kark and Taylor[2] have recently described a satisfactory way for preserving thromboplastin extract by means of the lyophile procedure of Flosdorf and Mudd.

---

[1] *Zentr. f. Bak.* (*Referate*) *B.C.* xxix, No. 5–6, 1938; *Népegésségugy,* No. 21, 1938.

[1] A. J. Quick, M. Stanley-Brown and F. W. Bancroft, *Am. Jour. Med. Sci.*, 190: 501, 1935; A. J. Quick, *Jour. Am. Med. Assn.*, 110: 1658, 1938; 111: 1775, 1938.

Thromboplastic activity is destroyed by oxidation. If dried rabbit brain be allowed to remain in contact with air, it slowly turns yellow and a concomitant loss of potency occurs. By storing the reagent in an evacuated tube, oxidation is prevented and the activity is retained apparently indefinitely. As an example, a preparation made on March 3, 1938, was tested on June 6, 1939, and found it clotted human plasma in 11½ seconds. The unused portion of the sample was resealed under vacuum and tested on June 24, 1940. Again clotting occurred in 11½ seconds.

Thromboplastin possesses a relative but not an absolute species specificity. Rabbit thromboplastin appears to be specific for the plasma of man, dog, cat, horse and cow, but not for the plasma of the guinea pig or for birds. It is interesting to note that repeated search has failed to find any better source for thromboplastin than rabbit brain.

Armand J. Quick

Marquette University School of Medicine

A STOPCOCK LUBRICANT FOR USE WITH SOLVENTS, ACIDS OR ALKALIES

During the past few years the writer has done considerable work with solvents such as carbon disulfide, petroleum ether, acetone and other similar solvents in separatory funnels and burettes.

Many different compounds have been used as stopcock lubricants. Some of these are good for certain solutions but unsatisfactory for others.

About two years ago while searching for a satisfactory stopcock lubricant for use with carbon disulfide the writer tried some powdered graphite which was on the shelf in the laboratory. It has proved to be a valuable substance for use as a lubricant where the ordinary compounds are dissolved away.

Graphite is insoluble in all ordinary solvents and is not affected by acids or alkalies. It does not allow the stopcock to bind and it gives a very satisfactory seal. Only a very small amount should be used. A stopcock once coated usually lasts a long time.

P. W. Rohrbaugh

California Fruit Growers Exchange,
Ontario, California

SHADOWGRAPH RECORDING OF AVENA COLEOPTILE CURVATURES

Growing oats in battery jars, in place of specialized seed holders, for the Went coleoptile assay method for auxin, seems to have a number of distinct advantages. When this technique is employed, shadowgraph records may be conveniently taken with the aid of an easily constructed device described below and figured in the accompanying drawing.

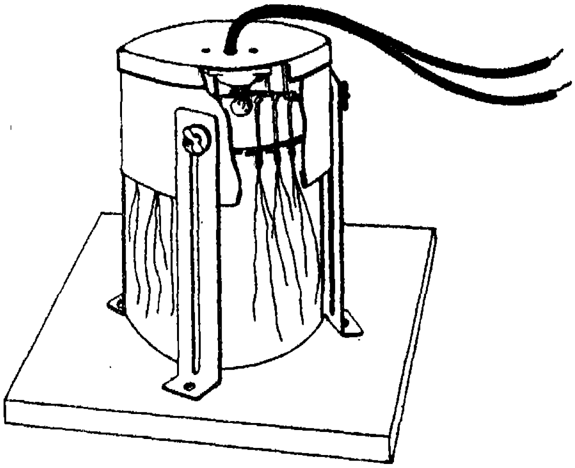

Fig. 1.

A copper cylinder 4″ in diameter and 3″ in height is made movable up and down along slots in three copper legs attached securely to a base board. The cylinder may be held in any position by means of winged nuts that tighten against the legs on screws attached to the cylinder. The lower rim of the cylinder is curled up on the inside to support a strip of photographic paper. Covering the cylinder is a copper lid, in the center of which is placed a small single filament flashlight bulb operating on two dry cells.

We have used this set-up with battery jars 3⅞″ in diameter and 5″ in height in which 20 to 25 oats are able to grow uniformly. Satisfactory results have been obtained with both single and double exposures of the reacting coleoptiles.

Harry G. Albaum
Samuel Kaiser

Brooklyn College

BOOKS RECEIVED

Arensberg, Conrad M. and Solon T. Kimball. *Family and Community in Ireland.* Pp. xxix + 322. Illustrated. Harvard University Press. $3.50.

Beaver, William C. *Fundamentals of Biology.* Second edition. Pp. 889. 301 figures. Mosby. $4.00.

Frank Howard Lahey Birthday Volume, June 1, 1940. Pp. xiv + 466. Illustrated. Charles C. Thomas.

Parsons, R. H. *The Early Days of the Power-Station Industry.* Pp. x + 217. 24 plates. 5 figures. Cambridge University Press, Macmillan. $3.50.

Plummer, Wilbur C. and Ralph A. Young. *Sales Finance Companies and Their Credit Practices.* Pp. xxiii + 298. National Bureau of Economic Research. $3.00.

Prescott, Samuel C. and Cecil G. Dunn. *Industrial Microbiology.* Pp. x + 541. 60 figures. McGraw-Hill. $5.00.

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[2] A. W. Souter, R. Kark and F. H. L. Taylor, Science, 91: 532, 1940.

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MARIHUANA

By Professor ROGER ADAMS
UNIVERSITY OF ILLINOIS

THE term "marihuana" is commonly used to represent any part of the hemp plant or extract therefrom which induces somatic and psychic changes in man.

The hemp plant has been known since remote antiquity, having originated in central Asia and spread into practically all countries of the world. For centuries, the fiber of the plant has been used for clothing and rope; the seed have been pressed for oil. The oldest known reference to the hemp plant is in a Chinese treatise, "Rh-ya," written in the fifteenth century B.C. That hemp contains an intoxicating principle has also been known for centuries and records of this fact date back to 1000 to 1500 B.C. The medicinal action is mentioned in Sanscrit, Hindu and Chinese medical treatises published about the beginning of the Christian era. Hundreds of other references during the past nineteen hundred years discuss the physiological action of this plant.

Hemp is an herbaceous annual growing three to eighteen feet in height, depending on soil and climate. Botanically it belongs to the genus *Cannabis,* of which there is only a single species, *Cannabis sativa,* occurring in a few varieties; *Cannabis indica* is one of these. When the female plant is about to flower, the tops, which have large quantities of hairs, become covered with a multitude of pluricellular glandulose hairs. These appear as minute glistening points and are so numerous that the tops appear to be shining with dew. The tops are very sticky and when pressed emit a strong mint-like smell. The resin often spreads to the surface of the leaves or branches. It is largest in amount when flowers begin to appear and continues to form until the seeds are mature—it ceases when the seeds are ripe. Botanists have suggested that the resin is formed as a varnish to protect the seed while the sap is providing the fertilized ovules with the elements necessary for maturation. The amount of resin depends almost entirely on the climate, the largest, as might be expected, in hot dry climates such as Chinese Turkestan and smallest in temperate climates where there is plenty of moisture. The morphological characteristics of *Cannabis* are modified very easily—one variety to another—merely by change in climatic conditions. The resin appears to contain most of the intoxicating principle of the plant. The male plant during flowering also exudes a certain amount of resin but much less than that produced by the female plant.

In the far East the resin (called charas) was in the early days collected from the uncut plant in several ways. Men wearing leather coats walked through the hemp and the resin stuck to the leather from which it was scraped. Sometimes sticks with leather strips attached to the end were drawn over the flowering tops. The tops were sometimes rolled in the hands and the resin scraped from the hands onto a receptacle. From cut plants, the tops were pressed between cloths or rubbed between fine mattings. By any of these procedures, a dark resinous mass was obtained, which was purified somewhat by kneading with a little water to remove dirt and extraneous material and then stored in a dry atmosphere, since it deteriorates when damp.

The modern method, such as is used at the present time in Chinese Turkestan, consists in cutting and drying the female flower heads, crushing in the hands to a powder and sieving so that it attains the fineness and consistency of sand or sawdust. This powder is stored in rawhide bags for four or five months during the winter. With the onset of hot weather the material is taken out and exposed to the sun for a short time, sufficient to allow the resin to melt. It is stored again in hide bags of ten-pound to fourteen-pound capacity. After a few days the agglutinated mass is again taken out and kneaded well by means of wooden rods so that a certain amount of oily matter appears on its surface. The process of kneading is continued until each bag yields about one or two pounds of oil. At this stage the charas is transferred to fresh bags and is ready for sale. The product consists of a greenish-black mass with a peculiar and characteristic odor.

Another commonly used East Indian hemp product called bhang consists of the specially dried leaves and flowering shoots, chiefly of the female plant. The process is merely to cut and dry the plants and to separate therefrom the leaves by striking against a block of wood.

Another product is ganja. In Eastern Bengal at the present time hemp is cultivated for the production of this material. As the female plants begin to form the resin, all the large leaves on the stems and branches are removed. The smaller leaves and the brackets of inflorescence become agglutinated into a resinous mass. The plants are then cut about six inches from the ground and exposed to the rays of the sun for a few hours. The redundant portions of the stem which do not bear flowering heads are then cut off and those bearing flowering heads are arranged in a circle with the heads directed toward the center and overlapping each other. Treading and kneading is commenced. While holding the plant tight with the left foot, the laborers press down and trample with the right foot. The process is continued until the narcotic resin is pressed firmly among the flowers in the desired form. Fresh bundles are placed over those which have been already pressed and the treading is repeated. This goes on until the ring is about a foot in height after which the flowering twigs are removed. The resulting flat resinous mass is known as flat ganja.

Ganja and charas, admixed with tobacco, are generally smoked, while bhang is usually taken by mouth in the form of a beverage or confection. In northern Africa, the hemp tops and leaves are often mascerated with water to a fluid paste and swallowed whole. Frequently they are extracted with alcohol and the residues from the solvent admixed with jams. The powdered tops and leaves sometimes are mixed with crushed nuts as a stuffing for dates, Turkish paste or in cakes; or mixed with nuts, spices, oil and chocolate to a thick paste, which is chewed.

In the United States and in several other countries, the tops of the flowering plants are cut and dried, the coarse material removed and the product chopped to the proper particle size for incorporation in cigarettes. This is the form of hemp most commonly observed in illicit distribution in this country.

The names for hemp preparations are very numerous. In addition to those already cited, should be mentioned in particular the term, hashish, which is in common usage.

There is no satisfactory bioassay method for determining the potency of marihuana. The best procedure in animal testing is administration to certain types of dogs, after which the character and degree of the incoordination, particularly of the hind legs, are observed. This very subjective method gives information as to the intoxicating power of the test sample but furnishes no indication as to the active principle content. Decerebrated cats are not affected; it thus may be concluded that marihuana affects the cerebral hemispheres and therefore poisons the intellect.

The most careful study of the effect of marihuana upon humans has been made upon educated Europeans. An extensive survey of marihuana addicts among native North Africans and East Indians also has been reported. The general effect of marihuana is to weaken the individual's will, the faculty which controls, sorts out groups and correlates according to logical laws. Thus, in the case of the intoxicated subject, memory and imagination predominate, he becomes entirely absorbed in the past and the future and loses sight of the realities of the moment. *Cannabis* affects the mind most powerfully.

There are several successive phases to intoxication by hemp. The subject first feels himself strong, agile, elegant, capable of extraordinary feats of prowess. He experiences an intense desire to move about. Walking, jumping, dancing seem desirable, though he usually abstains from such action. Gradually his mind becomes filled with ideas foreign to the subject on which he is endeavoring to fix his attention. Suddenly he is overcome by absurd and irresistible laughter caused by any trifling incident, which very often is not amusing even to the slightest degree. Simultaneously, the addict needs conversation and talks excitedly. The conversation becomes more and more incoherent as the will loses its power to direct thought. Ideas well up incessantly in addicts, especially those with some education; they whirl through the brain, becoming ever more lively and striking, and are associated together in the most unexpected ways.

Gradually, as the action of the drug progresses, exact notion of persons and neighboring objects is lost, the emotions are extremely exaggerated and paradoxical. Mental confusion increases and moments of lucidity become shorter and shorter. Finally, the subject reaches the stage of a sensation of moral and physical lassitude; he wants complete silence; the least effort becomes an almost impossible exertion; the mind allows itself to be lulled into a state of apathy, indifference and complete calm. The Mohammedans called this "kif."

This state is marked by a complete change in notion of time. It appears infinitely slow, owing to the number and variety of impressions which rapidly enter the mind. These ideas, particularly those half-formed, seem innumerable, and since time is measured only by the memory of them it seems infinitely long.

The notion of space also is wholly impaired. The distance between the subject and a person standing quite near him appears tremendous. The hand seems to be separated by an enormous space from the glass it attempts to seize. Objects are seen through a mist so that outlines are indistinct and shapes are blurred. Sight and hearing are extremely acute, but the perceptions are distorted and the distortions are constantly varying. This is the stage of great suggestibility. Any impressions made on the senses immediately give rise to imaginary perceptions, illusions and hallucinations.

Succeeding this is a deep and heavy sleep. The subject upon awakening, in general, remembers what he experienced during his intoxication. Apparently a subconscious condition prevails, but the persistence of memory indicates that consciousness still subsists.

The order and the intensity of the various phenomena differ in each individual and depend frequently on the influence of outward circumstances at the moment. In most cases, an exaltation of the most common thoughts of the individual may be noted. Thus, it acts like most cerebral stimulants, including alcohol. The most intimate and secret thoughts of the marihuana subject are revealed by unconscious movements, acts, illusions and hallucinations, as well as by words.

Marihuana intoxication is accompanied frequently by disagreeable symptoms. Especially with an overdosage, and dependent on the environment, the subject before he reaches the euphoria stage may suffer excruciating pains in the head and neck and a feeling of torture. He may even imagine he is going to die and, in general, may go through a period of great anxiety. If he has an aversion to any one, his antipathy is transformed into a fierce hatred; he is convinced that he now has everything to fear from his enemies and that they are hatching some odious plot against him. There is only one step from the belief that danger is imminent. The addict often reaches this stage and becomes a prey to sudden fits of terror and irresistible criminal impulses. This accounts for certain violent reactions, sometimes murder of friends and relatives, committed under influence of the drug.

All these observations have been based, for the most part, on tests with educated Europeans who had ingested preparations through the mouth. An intensive study of North African native addicts has indicated some differences in effect from those just mentioned; thus, during the period of euphoria, a rapid sequence of amusing and witty ideas is replaced in the native by a flow of absurdities, coarse jokes and obscenities; the phase of motor excitation is little marked, possibly because of the fact that the native who desires complete intoxication always smokes reclining on cushions or mats.

The phenomena observed during hashish intoxication vary widely according to whether *Cannabis* is smoked or *Cannabis* preparations are ingested. If the resin content is approximately the same, the effects are more rapid (after fifteen minutes) when hemp is smoked than when it is swallowed (one to two hours or even longer).

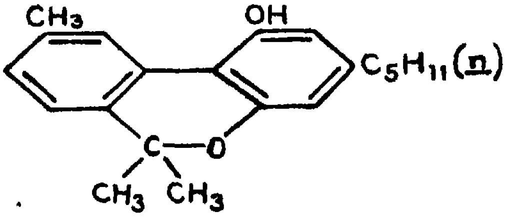
The North African natives generally are smokers and usually smoke to excess. Under these conditions the reactions are prolonged and after the final sleep the subject awakens in a stupor. The use of marihuana finally leads to loss of fitness for work and resistance to fatigue. Later, the subject is prone to headaches, loss of appetite and general degradation of the body. There is the factor of individual resistance, but the rapidity of degeneration depends on the quantity of the drug consumed.

The physiological action of marihuana may be described in most general terms as the release of inhibitions in the subject. As a consequence, an individual with natural criminal tendencies, which he controls under ordinary conditions, will commit crimes when under the influence of the drug. It is pretty securely established that this drug itself is not an aphrodisiac. It is impossible to predict the reactions in any particular subject. An exact knowledge of the intoxication of marihuana and its deleterious effects will have to await carefully controlled clinical experiments.

Ordinarily marihuana is not considered an addiction drug in the same sense as morphine, since the sudden cessation of the use of hemp does not give rise usually to the disquieting phenomena that accompany privation in the case of other narcotics. Its consumption in the United States, which had for several years increased, has recently been effectively checked.

The chemistry of marihuana is complicated and very confusing. Between 1840 and 1895 most of the chemical work consisted in rather unsuccessful attempts to find tests which would provide a means of identifying the presence of marihuana or an extract. In 1896, Wood, Spivey and Easterfield extracted hemp with petroleum ether and distilled from the extract a high-boiling fraction which apparently contained most of the active principle. This they called "red oil" because of its appearance. They were able to isolate from this oil by means of acetic anhydride a pure crystalline acetate from which by hydrolysis a straw-colored oil resulted, called by them cannabinol. For several decades, cannabinol was supposed to be the active principle of marihuana until finally it was proved otherwise. These early investigators contributed some facts toward the constitution of cannabinol but left the problem far from complete.

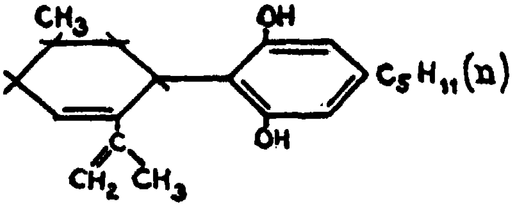
In spite of many attempts, no other investigators were successful in repeating the isolation of cannabinol until 1932, when Cahn again obtained this compound. He performed a series of brilliant researches from which he deduced a structure dubious in respect merely to the position of the hydroxyl and *n*-amyl groups. Just recently in the University of Illinois laboratories researches led to the postulation that the hydroxyl and *n*-amyl groups must occupy positions different from those suggested by Cahn. This new formula was demonstrated to be correct by an unequivocal method of synthesis. Cannabinol is 1-methyl-3-*n*-amyl-6,6,9-trimethyl-6-dibenzopyran and has structure I.



I

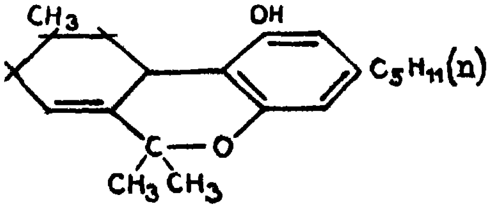
Most of the chemical work in the past has been done on charas. The experiments in the University of Illinois laboratories were performed with an extract from Minnesota wild hemp. From the red oil from this source, cannabinol has been isolated by a new procedure and also another pure compound, cannabidiol. Both substances were obtained in crystalline form. Cannabidiol composed about 45 per cent. of the red oil in hand and cannabinol about 15 per cent.

The study of the structure of cannabidiol is not yet complete, but the formula shown in II is doubtful only in respect to the position of the double bond in the left-hand ring. Cannabidiol, like cannabinol, is physiologically inactive.



II

Observation of structures I and II makes it appear likely that cannabidiol is a precursor of cannabinol. Thus, in the plant cannabidiol might isomerize readily to a tetrahydrocannabinol (III) which upon oxidation would be converted to cannabinol (I).



III

Such a series of reactions has now been consummated in the laboratory and thus confirms the probability that the plant reactions are similar.

Of peculiar interest and importance is the fact that the tetrahydrocannabinol formed by isomerization of the cannabidiol with various acidic reagents may be obtained in two forms depending on the reagent and physical conditions used in the reaction. One has a specific rotation fairly constant at about − 160° and the other at about − 240°. The evidence is that the structures of these differ merely in the position of the double bond or possibly stereochemically. The lower-rotating form has a very high marihuana activity, many-fold that of purified red oil. The higher-rotating form is less active than the lower-rotating. Both the tetrahydrocannabinols are hydrogenated to a single hexahydrocannabinol of specific rotation -70°, which is also physiologically active. It seems probable that the marihuana activity of red oil is due to one or more of these substances.

Several methods have been devised and successfully used for synthesis of tetrahydrocannabinols from simple starting materials. Homologs and analogs are also available through the new procedures. The possible marihuana activity of these compounds is now being tested.

Recently Todd has isolated from red oil in the form of a derivative a substance he calls cannibol. No information regarding its chemical characteristics is yet available.

Haagen-Smit and his coworkers reported a few weeks ago the isolation from red oil of a crystalline compound which has marked physiological activity. No information on the chemistry of the compound has yet been published.

Red oil is obviously a welter of closely related chemical substances very difficult to separate from each other. It is probable in view of the researches under way in the University of Illinois laboratories that one or perhaps more than one active principle exists and that they are tetrahydrocannabinols or closely related compounds. The probability is that the substances isolated by Todd and by Haagen-Smit will be found to be similar to these in character.

Hemp is readily identified when vegetative material is available for study. Tests are also available for identifying extracts of hemp. Reliable, scientific unequivocal methods for identifying one or more active constituents in red oil, however, must await the more extended study of the pure active compounds. Only then also will it be possible to perform quantitative clinical tests in order to obtain more accurate information on the physiological and psychological action of marihuana.

THE ROYAL SOCIETY OF CANADA

By Professor D. A. KEYS
MCGILL UNIVERSITY

THIS year the fellows of the Royal Society of Canada were the guests of the University of Western Ontario in London, for their annual meeting from May 20 to 22. The attendance was not as large as last year, but representatives from all parts of Canada attended and presented papers. The university buildings, situated in beautiful spacious grounds outside the city, presented a peaceful contrast to the present conditions in Europe, that visibly affected all who attended the meeting.

The presidential address, "A Study of the Organization and Work of the Royal Society of Canada," was delivered by Dr. H. M. Tory, following a complimentary dinner tendered the fellows, their wives and guests, by the City of London on Monday night, May 20. The president stated that the Royal Society of Canada differed in one respect from the similar society in England, in that it included under its organization all the intellectual movements which were deemed worthy of recognition. Thus with the Natural Science Sections III, IV and V, were associated the Literary Sections, including philosophy, literature, history and economics. After outlining the various contributions of the older sciences and literary fields of knowledge to our present western society, the lecturer concluded with the suggestion that we should at our annual meeting each year have a major symposium dealing in some form with the relations existing between the various sections. Two typical topics suggested were "The Effect of Science upon Literature in the Last Hundred Years" and "The Present State of Controversy between Science and Philosophy."

On the following evening, Dr. R. W. Boyle received the Flavelle Medal of the Royal Society for distinction in scientific subjects, in recognition of his researches, particularly on the development of "Asdics" and his work on ultrasonics. The presentation of the medal was followed by a scholarly lecture delivered by Dr. F. Cyril James, principal of McGill University, on "Science and Society," in which he traced the changes in western society brought about in the four centuries between 1475 and 1875 due to the impact of scientific discovery. He pointed out that the primary function of the social sciences is the charting for society of a course that is most appropriate in the light of the existing fund of human knowledge. Apparently the impact of science on society has not been wholly beneficial; the ethos of western society has not responded to the changes in its material environment, but if we are willing to face the major problem of deciding upon our ideals, the forces that science has placed at our disposal are sufficient to make the attainment of those ideals a practical possibility.

Section III (Chemical, Mathematical and Physical

Sciences) was held under the presidency of Professor J. A. Gray, who delivered the presidential address on "Studies in Beta and Gamma Rays," in which he outlined the early work done in Rutherford's laboratory at Manchester and the subsequent development of the theory of scattering and softening of the Gamma rays on passing through matter. Recent experimental results on the Beta ray spectra and the Gamma rays from Uranium X were presented by Dr. Gray. Five new fellows were elected to the section, Dr. A. N. Campbell, Professor P. E. Gagnon, Professor Gordon Pall, Dr. R. M. Petrie and Professor H. Grayson Smith.

Of the eighty-four papers presented to Section III, twenty-five were by title. Space permits the mention of only a few of those papers presented. Dr. S. A. Hodgson described the seismograph installation at the Lake Shore Mines, Kirkland Lake, Ont., and the results obtained in investigating the possibility of forecasting the rock-bursts which are prevalent in that mine. The results of experiments on the vibrations in aircraft, described by Dr. D. C. Rose, indicated the possibility of improvement in the design of such craft. Dr. J. S. Foster reported that he and his associates had obtained some new results in the Stark Effect, using Cu, Ni, Hg, Zn, Cd and Pb, using fields from 100 to 250 Kv/cm. R. G. Elson, Grayson Smith and J. O. Wilhelm described a new type of calorimeter for determining the specific heats of materials at liquid hydrogen temperatures. Among the results communicated, it was stated that the variation with temperature of the specific heat of manganese can be expressed by a Debye function with a characteristic temperature of 410° and a linear term 0.0042T. A very interesting investigation on the validity of the Ferry-Porter law in normal, enhanced and depressed states of visual sensibility, and the influence of stimulation of the senses of vision, hearing, taste and smell upon the sensibility of the organs of vision were reported by Dr. Frank Allen. It appears that stimulation of one sense causes a periodic rise and fall in another, the results confirming and extending the work of Kravkov. For example, stimulation of the ear by sounds makes red colors appear dimmer and green brighter when no rest interval is allowed, but after a rest interval of 3 minutes, the red appears brighter and the green dimmer. A number of papers on meteorology by the staff of the Meteorological Office were communicated by the director, John Patterson, who exhibited a new radio-sonde instrument by R. C. Jacobsen, now being used by the service. Dr. L. Gilchrist described geophysical results of electrical drill hole coring carried out with the assistance of A. R. Clark, and Dr. D. A. Keys gave the results of a magnetic survey on Calumet Island. Dr. D. K. Froman described a new 12-inch cloud chamber used in a magnetic field for the study of cosmic-ray mesotrons.

Among the fourteen mathematical papers read, Dr. Buchanan spoke on "Second Genus Crossed Orbits," in which he considered a special case of the restricted three-body problem. Dr. R. L. Jeffery gave a paper on the integration of functions in a complete normed sector space, in which he set forth a theory equivalent to that of G. Birkhoff. Dr. Gordon Pall delivered a paper on "Simultaneous Representation in Quadratic and Linear Forms," and among several papers read by Professor Synge, attention is drawn to a new electromagnetic energy-tensor. A direct application of the laws of conservation of energy and momentum leads to the equations of motion given by the Lorentz ponderomotive force, without the radiation term. Dr. W. L. G. Williams communicated the results of an investigation on hyperbolic trigonometry.

In the Chemistry Section Dr. E. W. R. Steacie and his students presented five papers on photosensitized reactions, in which the polymerization of ethylene was investigated, using different wave-lengths in the ultraviolet, and an estimate of the strength of the C–H bond was determined. Dr. P. Gagnon described the synthesis of some new hydrocarbons in the Indene series, and Dr. R. H. F. Manske described the structure of Hunnemanine. A large number of papers were read by Dr. R. H. Clark and his students. An examination of the phenolic constituents of the water soluble ethanolysis products of western red cedar, Douglas fir and western hemlock was made, and the oil isolated from the phenolic constituent in each case on methylation with diagomethane yielded a white crystalline compound with the same melting point as that from spruce and maple woods. Another paper described a method for the synthesis and isolation of glycuronic acid.

Professor Otto Maass was elected president of Section III and Professor J. K. Robertson, the secretary.

The feature of the meetings in Section IV (Geological Sciences) was the excellent address of the president, Professor J. J. O'Neill, on "The Exploitation and Conservation of Mineral Resources in a Balanced Development of Canada." He urged that while the mines are active in Canada's north, bringing men and money into the country, is the time to take preliminary steps toward permanent settlement; otherwise, when mines are exhausted the settlements will be deserted and become "ghost towns." Each district will have to be considered as an individual problem, and study of these problems should be begun at once. Agriculture in the few areas possible, reforestation, to be followed eventually by scientific lumbering, and the development of manufacturing industries near sources of power were some of the possibilities suggested.

Among the twenty-eight papers presented, special mention may be made of one by P. M. Hurley, C. Goodman and R. D. Evans on the investigations of the helium method of age determination. They show that the agreement between the results obtained using samples of pyroxene from specimens is much better than that obtained from determining the age from felspar. It is suggested that pyroxene retains its helium and is more suitable for such age determinations. Dr. J. E. Gill called attention to the unsatisfactory state of fault nomenclature and suggested certain improvements. As a result, a committee was appointed to study the question and report at the next meeting. J. T. Wilson summarized the results of a study of air photographs covering a large belt of the North West Territories. The investigation showed this part of the Canadian Shield to be a mosaic of fault blocks, some having horizontal movements as much as eighteen miles.

The presidential address of Section V (Biological and Medical Sciences), entitled "The Causes of Hybrid Sterility and Incompatibility," was delivered by Professor W. P. Thompson, of the University of Saskatchewan, and stressed particularly the time in the life-cycle at which the causes may operate.

A notable feature of the meeting was the group of papers on fish (and particularly on salmon). Professor A. G. Huntsman described the habits of Atlantic salmon and discussed deaths due to high water temperatures in the rivers of Eastern Canada, while Professor E. M. Walker presented the work of K. C. Fisher and P. E. Elson on temperature preference in Atlantic salmon and speckled trout. W. A. Clemens reported A. L. Pritchard's work on the age of coho and spring salmon of British Columbia and his own work on sockeye salmon in the same region. Attempts to explain the origin of kokane (a variety of sockeye salmon) were made in a paper by W. E. Ricker, reported by R. E. Foerster. The close affinities of the Coregine fishes of Canada with Siberian species were dealt with by J. R. Dymond.

Desiccation in Southern Ontario, as reflected in the decreasing mileage of streams, was the subject of a paper by A. F. Coventry, read by J. R. Dymond. This led to an animated discussion as to the causes of desiccation.

Botanical papers included one by Professor R. B. Thomson on the study of sporelings in the vascular cryptogams as a basis for the interpretation of seedling organization, another by H. B. Sifton on the development of the air spaces in the leaf of Labrador tea, and two by Professor E. H. Moss on interxylary cork in *Artemisia*. Professor G. W. Scarth summarized work on frost and drought resistance carried out with J. Levitt, B. Siminovitch and others and described the changes in the physical state of protoplasm associated with hardening.

James Miller discussed the parts played by the basal and prickle layers of the epidermis in regeneration and neoplasia, and M. L. Barr described the effect on the synapse of axon reactions in motor neurons. C. C. Macklin demonstrated that after over-inflation of the excised lung the internal septa and sheaths of the pulmonary blood vessels are similarly pneumatized. Dr. Benjamin Kropp brought forward much material to demonstrate that in spontaneous and therapeutic abortions structural abnormalities were present in the villus capillaries and villus epithelium. H. Wasteneys, B. F. Crocker and P. Hamilton reported that deuterium-labeled proteins are useful for the study of digestion in the dog. Madge Thurlow Macklin gave evidence that tumors in man have a genetic basis, and Lionel Penrose presented studies on the grandchildren of consanguineous unions. Dr. D. A. Scott discussed the structure of insulin crystals prepared from bison and human pancreases in comparison with those previously prepared from other sources. Dr. Leslie Young described his synthesis aryl hydrogen sulfates *in vitro*.

Drs. Clark, Cleghorn, Ferguson and Fowler demonstrated that adrenal insufficiency results in a decrease in extracellular fluid and in plasma volume, that the percentage decrease of the former is less than the latter and that the decrease in plasma was not sufficient to account for circulatory collapse. Dr. Bram Rose presented evidence to show that in various types of shock there is a decrease in blood histamine. Dr. N. W. Roome advanced further evidence tending to dissociate the sympathetic nervous system from shock due to hemorrhage. Professor F. R. Miller demonstrated the local effects of eserine and acetylcholine on the electrogram of the cerebellar cortex. Dr. P. J. Maloney presented further evidences of the influence of bile salts on the flocculation of toxin. Professor G. B. Reed described a semi-synthetic medium for the production of gas gangrene and tetanus toxins.

E. Horne Craigie described the area of distribution of the middle cerebral artery in birds and the form of the capillary bed of the central nervous system in *Dermophis*. J. McDunnough discussed some marine Coleophoridae, and C. McLean Fraser described hydroids of the Pacific Coast.

Other papers dealt with genetics of size (J. W. MacArthur) and the structure of homotypic and somatic chromosomes (L. C. Coleman).

Principal R. C. Wallace, of Queen's University, was elected president of the society for the ensuing year.

SCIENTIFIC EVENTS

CHEMISTRY EXHIBITS OF THE CHICAGO MUSEUM OF SCIENCE AND INDUSTRY

Dr. C. Robert Moulton, curator of chemistry at the Museum of Science and Industry in Jackson Park, has announced the opening of a new series of exhibits in the chemistry sequence.

In the first room of this new series are exhibits designed to show how the chemist distinguishes various kinds of matter by such properties as color, taste, flavor, odor, appearance, density, crystalline form, hardness, malleability, ductility, heat and electrical conductivity, solubility and chemical activity.

In the second room are shown the natures of, and differences between, atoms, molecules, elements, compounds, pure substances and mixtures. Here, too, is shown the history of atomic theories from ancient Greece to the present day, including the contributions of Dalton and Langmuir.

The third room contains a picturesque reproduction of a sixteenth century alchemical laboratory with its strange collections of glass retorts and odd materials, where the eternal search for the philosopher's stone to turn base metals into gold went on. Adjacent to this is a 20th century chemical laboratory furnished with the most modern equipment.

The visitor passes next through a series of exhibits, many of which he may operate by pushing a button, on the fundamental laws, relationships and classification of chemistry.

Next comes a room full of rather spectacular exhibits showing typical chemical reactions, procedures and processes such as the burning of iron in oxygen, the making and burning of gunpowder, potassium burning on water, the violent heat reaction of thermit which makes it so useful in welding, electricity used to decompose water, growing crystals by electricity and many other chemical experiments.

Here a transition occurs from chemistry as a pure science to its industrial applications. Such applications of chemistry to industry as the manufacture of salt, phosphorus and phosphates, carborundum and aloxite abrasives, industrial alcohol, carbureted water gas and coal gas are shown.

THE CONCILIUM BIBLIOGRAPHICUM

The National Research Council is informed that the Concilium Bibliographicum, the headquarters of which have been in Zurich, Switzerland, is desirous of disposing of the materials which it has acquired since its establishment by Dr. Herbert H. Field in 1895. This is necessitated by decision to terminate the operations of the concilium this summer. The materials to be disposed of consist of valuable card indexes to biological literature for the period of existence of the concilium, arranged both taxonomically and by authors' names, and covering the fields of paleontology, general biology, zoology, microscopy, anatomy and physiology; and also the catalogue of this literature published in book form as the "Bibliographia Zoologica" (Vols. 23–43; 1912–1934), and a large library of biological periodicals.

The attention of American biologists and librarians is called to this matter, since this appears to be the final opportunity at which it will be possible to obtain the card catalogues published by the concilium, or sections of these catalogues, and since from the library of the concilium it may be possible to obtain sets of important scientific journals desired by institutional libraries in the United States.

It is suggested that any one interested in acquiring these materials address Professor Doctor Johannes Strohl, director, "Concilium Bibliographicum," Waldmannstrasse 12, Zurich, Switzerland.

INTER-AMERICAN SOCIETY OF MICROBIOLOGY

During the period since September, 1939, when, at the close of the third International Congress of Microbiology, the initial steps were taken for the establishment of the Inter-American Society of Microbiology, work has been actively progressing toward the formation and organization of the committees throughout Latin-America which will foster the interests of the society in their several countries. These committees will also determine the final form which the society is to take in order that it may be of the utmost service to all workers in the microbiological sciences.

The following list records the chairmen of the National Committees thus far established:

Argentina—Dr. Alois Bachman, *chairman*, professor of bacteriology, Faculty of Medical Sciences, Buenos Aires.

Chile—Dr. Eujenio Suarez, *chairman*, director of the Bacteriological Institute of Chile, Santiago.

Colombia—Dr. Bernardo Samper, director, National Institute of Hygiene, Bogota.

Costa Rica—Dr. Clodomiro Picado, bacteriologist-in-chief, San Juan de Dios Hospital, San Jose.

Cuba—Dr. Pedro Kouri, *chairman*, professor of parasitology, School of Medicine, Havana.

Ecuador—Dr. Juan Antonio Montalvan, professor of hygiene, Faculty of Medical Sciences, Guayaquil.

El Salvador—Dr. Salvador G. Aguilar, director, Laboratories of Public Health, San Salvador.

Guatemala—Dr. Carlos Estevez, *chairman*, director-general of Public Health, Guatemala.

Mexico—Dr. Jose Zoyaya, *chairman*, director, Institute of Hygiene, Popotla, Mexico, D. F.

Nicaragua—Dr. M. A. Sanchez Virgil, director, National Institute of Hygiene, Managua.
Panama—Dr. A. Vincente Mastellari, Department of Public Health, Panama.
Peru—Dr. Telemaco Battistini, *chairman*, director, National Institute of Hygiene and Public Health, Lima.
Uruguay—Dr. Estenio Hormaeche, *chairman*, professor of bacteriology, Faculty of Medicine, and associate director, Institute of Experimental Hygiene, Montevideo.
Venezuela—Dr. L. Briceno Rossi, *chairman, formerly* director of Public Health, Caracas.

In all these countries except Colombia, Costa Rica, Ecuador, El Salvador, Nicaragua and Panama, committee organizations have been completed.

In Brazil, where the first Inter-American congress is scheduled to take place, the organization of the committee is under way, as is also the formulation of plans for holding the congress. Dr. A. Fontes, director of the Institute Oswaldo Cruz, will be the president of the congress.

There remain several important steps to be taken. Among these are the following: (a) Organization of the appropriate branches of the Inter-American Society in Canada and in the United States; (b) establishment of a mutually helpful relationship between the Inter-American Society and the International Society of Microbiology, looking forward to the next congress of both societies; (c) establishment in the United States of an *Inter-American Journal of Microbiology*, to be published in English and open to contributors from all American countries. Decision on these matters should be made by the microbiological societies now existing in the United States and Canada.

F. Duran-Reynals,
Executive Secretary

THE AMERICAN MINING CONGRESS

In announcing the preliminary program for the seventh annual metal mining convention and exposition of the American Mining Congress, which will be held at Colorado Springs from September 16 to 19, attention is called to the program of the government for acquiring supplies of the vitally needed "strategic" minerals. It is announced that a full session of the convention will be given over to consideration of the part which minerals play in the present emergency. Another session will study and discuss the effect of the war on supplies, international movements, domestic markets, prices, etc., of each of the principal metals.

Dr. C. K. Leith, mineral adviser to the National Defense Advisory Commission, will discuss the "Role of Minerals in the Present War," followed by authorities from the U. S. Bureau of Mines and the mining industry on the nation's needs for war minerals. Ellsworth C. Alford, counsel of the American Mining Congress, Washington, D. C., will speak on "National Defense and National Finance."

Senators James Murray, of Montana, and Key Pittman, of Nevada, will both address the meeting. Senator Murray will outline plans for the expansion of Reconstruction Finance Corporation loans for mining. Senator Pittman will address the delegates on the "Future of Gold and Silver in the Light of World Conditions." Colonel Philip B. Fleming, wage-hour administrator of the U. S. Department of Labor, will also speak.

Over a period of years, the metal mining industry has urged the Congress to amend the Wagner Labor Relations Act to provide for more equitable and just administration, and this year the industry expects to secure a full report of the activities of the special committee investigating the National Labor Relations Board from Edmund M. Toland, general counsel to this committee. Mr. Toland is expected to address the session devoted to labor problems. "Present-day Industrial Relations" will be discussed at the same session by C. S. Ching, director of industrial and public relations of the United States Rubber Company.

Progress in mine safety and health, dust control and the problem of sick absenteeism will occupy another full session. Other sessions will be devoted to reviews of the progress in mining geology, mining methods and equipment, the milling of metallic and non-metallic ores and developments in placer mining. Supplementing these discussions will be exhibits of the latest types of mining and milling equipment, participated in by nearly a hundred leading manufacturers of mining machinery. Taxation, public relations, public mineral land withdrawals and industrial uses for silver are other subjects included in the program.

THE LOS ANGELES MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

The Pacific Coast convention of the American Institute of Electrical Engineers will be held at Los Angeles from August 27 to 30.

The address of welcome at the opening session will be given by N. B. Hinson, chairman of the convention. President R. W. Sorensen will follow with an address on "Science and Superstition"; Douglas Shearer, sound director of the Metro-Goldwyn-Mayer Studios, will also speak.

In addition to the five technical sessions and two student sessions, a technical conference will be held on the subject of governors, frequency control and load swings, with several leading engineers entering into the discussion. The subjects of the technical sessions are Protective Devices, Power Transmission and Distribution, Electrical Machinery, Instruments, Measurements and the Basic Sciences. The students' sessions are to be held in the afternoons of Wednesday and Thursday. On Thursday morning Major E. H. Armstrong, of Columbia University, will give an address on "Frequency Modulation."

There will be an informal reception by the president at the Ambassador Hotel on Tuesday at 5:30 P.M. and in the evening a student counselor dinner and conference, followed by a lecture on "Comets and Meteors" at the Griffit Park Planetarium. A golf tournament is planned on Thursday and in the evening there will be a dinner at the Riviera Club, amusements and dancing.

Points of interest selected for inspection trips are as follows:

Columbia Steel Plant at Torrence.

KNX Broadcasting Transmitter.

Ship-to-Shore Radio Station of the Southern California Telephone Company.

New Receiving Station E of the Bureau of Power and Light.

Laboratories of the California Institute of Technology.

The 200-Inch Telescope at Mount Palomar.

The 200-Inch Mirror, now undergoing final polishing at the California Institute of Technology.

If conditions permit, a visit to an aircraft factory may be included, although this of course will depend on national defense requirements at the time.

Trips will also be available to the Huntington Library and Art Gallery and to see the famous stained-glass window of the "Last Supper" at Forest Lawn, as well as to Chinatown and the Olvera Street Mexican Village. Additional trips to other local points of interest will be arranged on request.

RECENT DEATHS AND MEMORIALS

Dr. James Flack Norris, professor of organic chemistry at the Massachusetts Institute of Technology and director of the research laboratory of organic chemistry, died on August 3 at the age of sixty-nine years.

Frank Bond, ornithologist, formerly chief of the United States Geographic Board, died on July 2 at the age of eighty-four years.

Nature reports the death of Dr. G. S. Blake, formerly geological adviser to the Palestine Government.

At the regular meeting on July 10 of the California Academy of Sciences the program of the meeting was devoted to a commemoration of the life and work of Edward Payson Van Duzee, late curator of the department of entomology of the academy. Short addresses were made by Dr. Frank E. Blaisdell, research associate; Professor E. O. Essig, University of California; Dr. Edwin C. Van Dyke, professor emeritus of the University of California and curator emeritus of the California Academy of Sciences; Professor Charles W. Woodworth, professor emeritus, University of California, and by Director Robert C. Miller and President Frank M. MacFarland, of the California Academy of Sciences.

SCIENTIFIC NOTES AND NEWS

Dr. Eugene Van Cleef, professor of geography at the Ohio State University, has received a special award from Delta Phi Epsilon, the professional foreign service fraternity, in recognition of his "distinguished service in education and international relations."

C. A. Zapffe and Dr. C. L. Faust, of the Battelle Memorial Institute at Columbus, Ohio, have been awarded the 1940 Proctor Memorial Award of the American Electroplaters' Society for their paper on the "Metallurgical Aspects of Hydrogen in Electroplating."

James W. Hook, of New Haven, Conn., president and director of the Geometric Tool Company and of the United Illuminating Company, has been awarded the Marston Medal of the Engineering Division of the Iowa State College in recognition of "his ability as a manufacturer, his leadership in movements for sane industrial relationships, the faithful discharge of his civic responsibilities and his keen interest in community affairs."

Dr. A. M. H. Gray, physician in charge of the skin department of University College Hospital, London, and lecturer in dermatology in the Medical School, was elected on July 2 president of the Royal Society of Medicine.

Dr. E. R. Martell, assistant dean of the School of Forestry of the University of Idaho, has been appointed head of the department of forestry and conservation of the Agricultural Experiment Station at Purdue University. He succeeds Professor B. N. Prentice, who will spend a larger part of his time in teaching.

Dr. Carl Neuberg, formerly professor at the University of Berlin, until his retirement with the title emeritus in 1937 for twelve years director of the Kaiser Wilhelm Institute for Biochemistry, has been appointed research professor of chemistry at the Washington Square College of Arts and Sciences of New York University. He will take up the work in September, following his arrival in the United States from Palestine, where he has been teaching at the University of Jerusalem.

ACCORDING to *Nature* Dr. Richard Kroner, the German Jewish philosopher, formerly professor at Dresden, Kiel and Berlin, who left Germany two years ago, has been appointed professor of logic and metaphysics at McGill University.

DR. A. RAYMOND DOCHEZ, John E. Borne professor of medical and surgical research at the College of Physicians and Surgeons, Columbia University, has been appointed chairman of the department of bacteriology.

DR. C. A. BUEHLER, professor of chemistry at the University of Tennessee, became head of the department of chemistry on July 1.

DR. JOHN R. PAUL, of the School of Medicine of Yale University, has been promoted to a professorship of preventive medicine. Dr. Leon S. Stone has been promoted to a professorship of comparative anatomy.

DR. EDWARD DAWSON DAVY, professor of pharmaceutical chemistry, has been appointed acting dean of the School of Pharmacy of Western Reserve University, filling the vacancy left by the resignation of Dean Edward Spease, who will direct the newly formed pharmaceutical department of the National Association of Retail Druggists.

DR. H. R. JOSEPHSON, for the past six years expert in forest economics at the California Forest and Range Experiment Station, has been appointed a member of the faculty of the department of forestry of the College of Agriculture of the University of California.

DR. J. MERRIAM PETERSON, head of the testing department of the Hercules Powder Company, Wilmington, Del., has been appointed assistant professor of chemical engineering at Cooper Union, New York City. He will give courses in physical chemistry and chemical engineering thermodynamics.

DR. EDWARD J. STIEGLITZ, associate professor of clinical medicine at the Rush Medical College of the University of Chicago, will join the staff of the National Institute of Health, Washington, D. C., where he will conduct clinical and experimental research on the problems of aging.

DR. CHARLES HUBBARD JUDD, consultant of the National Youth Administration for the past two years, formerly professor of education and chairman of the department of psychology at the University of Chicago, has been appointed director of student work. He is succeeded as consultant by John H. Lasher, Wisconsin state youth administrator.

ACCORDING to the *Journal* of the American Medical Association, Dr. Hiram J. Bush, of the U. S. Public Health Service, has been appointed director of the Henry R. Carter Memorial Laboratory for Malarial Research at Savannah. He succeeds Dr. Thomas H. D. Griffitts, who was transferred to Puerto Rico several months ago, as chief quarantine officer. Dr. Charles M. McGill has been acting director of the laboratory since Dr. Griffitts left.

DR. WALLACE E. RICHMOND, formerly in charge of the x-ray laboratory of the department of mineralogy of Harvard University, has been appointed x-ray crystallographer in the U. S. Geological Survey.

DR. KARL F. KREBS, who recently received the doctorate in organic chemistry at the University of Illinois, has been appointed a member of the staff of the department of research and development at Bloomfield, N. J. of the Bakelite Corporation, unit of the Union Carbide and Carbon Corporation.

THE Rockefeller Foundation has made a grant of $22,500 over a five-year period for researches in agricultural bacteriology under the direction of Dr. Perry W. Wilson, of the University of Wisconsin.

DR. BRUNO ROSSI, research associate at the University of Chicago, who was recently called to Cornell University, left Chicago for Mt. Evans, Colo., on August 5, with a party of physicists from the university. It is planned to make a study of cosmic rays at Mt. Evans, where stations will be established at widely separated heights on the mountain side. The number and velocity of the rays will be measured and photographs will be made of the showers. The headquarters of the expedition will be at the high altitude research laboratory on Mt. Evans, which was built cooperatively by the University of Denver, the Massachusetts Institute of Technology and the University of Chicago.

THE Research Laboratory of the General Electric Company at Schenectady has two visiting lecturers this summer. Professor J. G. Kirkwood, of Cornell University, winner of the American Chemical Society Award in Pure Chemistry for 1936, is giving a series of lectures on the theory of dielectric polarization. Professor H. Mark, until recently professor of chemistry at the University of Vienna and at present a member of the staff of the Polytechnic Institute of Brooklyn, will present a course on high polymers. In addition to giving the graduate courses, the visitors will discuss work in their fields with members of the laboratory staff.

DR. JAMES H. KIMBALL, director of the U. S. Weather Bureau in New York City, was the guest lecturer at the opening of "Weather or Not" on August 1 at the Hayden Planetarium of the American Museum of Natural History.

THE annual meeting of the Corporation of the Marine Biological Laboratory will be held in the auditorium of the Laboratory at Woods Hole, Mass., on

Tuesday, August 13, at 11:30 A.M., for the election of officers and trustees and the transaction of such business as may come before the meeting.

A SUMMER Intensive Training Course in General Semantics will be held from August 23 to 30 at the Institute of General Semantics, Chicago. The work will conclude the summer schedule and will be under the direction of Dr. Alfred Korzybski. Information and an outline of the program can be obtained from M. Kendig, educational director, Chicago.

AT a special meeting of the Research Council on Problems of Alcohol of New York City on July 9, six types of membership, each requiring annual dues, with the exception of life membership, were inaugurated. These types of membership are as follows: regular membership, $5 per year; contributing membership, $10 per year; supporting membership, $25 per year; sustaining membership, $50 per year; patron, $100 or more per year, and life membership, $1,000 or more. Each membership includes a subscription to the *Quarterly Journal of Studies on Alcohol,* which has become the official organ of the council.

THE librarian of St. Bonaventure College, New York, the Rev. Irenaeus Herscher, reports that the college has arranged to acquire a microfilm library of 26,143 volumes, products of the printing press from the time that the first book was printed in English, in 1474, to 1640, covering almost two hundred years. The completion of this microfilm library was to have taken three years, but it is now estimated that it will take another year. Already 200,000 pages of the books have been photographed, and these will be available before the college reopens on September 17. The volumes being microfilmed represent many millions of dollars where value can be estimated. Many of them are considered priceless. The pages of the books are reproduced on the reels of film and they are shown full size and clearly readable on the screen of a reading machine.

Two grants have been made to the Louisiana State University by the General Education Board. One, of $5,000 a year over a five-year period beginning on July 1, is to provide visiting teachers in the department of sociology. The other is a $9,500 grant for 1940–41 to defray expenses of courses in techniques of population research in the department. The courses are to be taught by Dr. Warren S. Thompson, director of the Scripps Foundation for Research in Population Problems at Miami University, during the second semester of the session. The grant makes provision for six fellowships to be used at Louisiana State University during Dr. Thompson's period of service. Under the terms of these grants and in accordance with plans developed by Dr. T. Lynn Smith, head of the department of sociology, the university will be enabled in each year to obtain as a visiting professor a young sociologist of decided promise from one of the other universities. Also additional time will be afforded the members of the faculty for research.

ACCORDING to the *Geographical Journal,* London, the Montreal Society of Geography, of which M. François Vézina is president and Dr. Benoît Brouillette is secretary-general, is housed at the École des Hautes Études Commerciales of the University of Montreal, and will work in cooperation with that body. In addition to stimulating public interest in geography by lectures and excursions, it aims particularly at encouraging geographical research, the teaching of geography from the primary school to the university on modern lines and the study of the regional geography of Quebec and the national geography of Canada. The geographical nomenclature of the Province of Quebec will also form another sphere of work. The society proposes to establish a specialized library, and, when funds permit, to publish a bulletin. Considerable support has already been received, and several meetings have been held.

ARRANGEMENTS have been made between the various Imperial Agricultural Bureaus whereby any publication upon the preparation of which two or more bureaus collaborate shall be included in a new series entitled "Joint Publications." It has been decided to regard the earlier Joint Publications on "Vernalization and Phasic Development of Plants" and "Erosion and Soil Conservation," as Nos. 1 and 2 in this series. Other joint publications produced in recent years but already out of print have not been given numbers in the series. The Imperial Bureau of Plant Breeding and Genetics and the Imperial Bureau of Pastures and Forage Crops have now produced Joint Publication No. 3, entitled "The Breeding of Herbage Plants in Scandinavia and Finland." It is a symposium consisting of a series of articles by specialists in the respective countries. G. Nilsson-Leissner, F. Nilsson, E. Åkerberg and R. Torssell contribute articles on work in Sweden, H. N. Frandsen, H. Wexelsen and O. Pohjakallio on Denmark, Norway and Finland, respectively.

Nature states that sixty-six Canadian university students will take training in research in Canadian institutions under National Research Council Scholarships during 1940–41. While the majority of these students will be engaged in chemical and physical investigations, such biological studies as genetics, plant pathology, physiology and zoology will each have a quota of students. Two Special Scholarships of 1,000 dollars each will be held in the Division of Chemistry at the National Research Council laboratories, by R. L. Cunningham and R. B. Harvey of McGill University. Four fellowships of the value of 750 dollars each, and thirty-seven studentships of the value of 650 dollars each, will be held at Canadian universities directly under the auspices of the National Research Council. With the cooperation of Canadian universities, the National Research Council is also awarding twenty-three bursaries of 250 dollars each. These bursaries are available to students of high attainments who have just graduated and are ready to take their preliminary training in research.

At the Toronto meeting of the American Society of Biological Chemists a committee was appointed to consider the relationship of chemists to the work in clinical laboratories. The committee, consisting of Dr. William C. Rose, president elect; Dr. D. D. Van Slyke and Dr. Vincent du Vigneaud, chairman, was authorized to act for the society and has submitted the following report: The American Society of Biological Chemists wishes to express its full agreement with the policy set forth in the resolution adopted by the American Chemical Society with regard to clinical laboratories: "In order that the public may be protected the states should license individuals engaged in determining data of a chemical nature bearing upon the public health or upon which the diagnosis and treatment of disease may be based, and that the states also should approve laboratories engaged in such work and their directors, solely on the basis of adequacy and competence and without assuming that any particular degree such as doctor of medicine, doctor of philosophy or doctor of science, is in itself a guarantee of the qualifications requisite to ensure the accuracy and experience necessary to the public welfare."

DISCUSSION

BACTERICIDAL FILTRATES FROM A MOLD CULTURE*

Although there is a large literature on bacterial antagonism, going back to the work of Metchnikoff and culminating in the striking results of Dubos at the Rockefeller Institute, there is, to my knowledge, only one recorded case of a bactericidal product formed from a mold. In 1929 Fleming[1]—confirmed later by Reid[2]—found that filtrates from a particular *Penicillium* displayed marked inhibitory effect on the growth of many gram-positive and some gram-negative organisms, but without bactericidal effect. Gratia and Dath[3] reported a *Streptothrix* whose filtrates were highly bactericidal to a variety of bacteria.

In this laboratory a mold—tentatively identified by Dr. Charles Thom of Washington as *Aspergillus flavus*—has been found which grows readily in liquid media yielding filtrates that are definitely bactericidal for some gram-negative as well as gram-positive bacteria. A series of other *Aspergilli*—all kindly supplied by Dr. Thom—has been examined in this way, with widely varying results. Another strain of *Aspergillus flavus* was found totally inactive, while several representatives of the oryzae-flavus group, as well as a strain of *Aspergillus parasiticus*, have shown activity in one degree or another; but none has been as active as the original organism. The results with any mold are fundamentally dependent upon the medium. Various media and conditions of growth are being studied, and at the time of writing a method has been found to concentrate the active material, although nothing is yet known as to its nature. The results so far noted stem from an inherent property of the mold as against properties developed by adaptation in the sense of Dubos and of Waksman and collaborators.[4] However, attempts are being made to grow the mold on bacterial cultures as sources of nutriment with the hope of accentuating the activity already existing.

A detailed report of this work will be published as results warrant. In view of the growing interest and more numerous investigations in this field of microbial antagonism it has seemed appropriate to publish this brief record at this time.

Edwin C. White

Brady Institute,
The Johns Hopkins Hospital

ANTLER-EATING BY RODENTS

Carlson's query[1] as to the presence of an "urge" or appetite in the gray squirrel for calcium and phosphorus during pregnancy and lactation as evidenced by the eating of bone brings up a related question which may have some bearing on the case. This is a question of what becomes of deer antlers after they are shed.

It might be supposed that if the antlers persisted on the ground for several years after shedding they would become quite common on certain portions of our western range where it is heavily stocked with deer. It has been my observation through many years afield on such ranges that the antlers are exceedingly scarce. I believe this has been corroborated by many other observers. If it is actually a fact, the obvious implication is that the antlers disappear rapidly after being shed.

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* This work is being carried out with the aid of a grant from the American Association for the Advancement of Science.

[1] *British Jour. Exp. Path.*, 10: 226, 1929.

[2] *Jour. Bacteriology*, 29: 215, 1935.

[3] *Compt. Rend. Soc. Biol.*, 92: 461, 1925.

[4] National Academy of Sciences, Washington, April, 1940. A report of this work was seen in the *New York Times* of April 24, 1940.

[1] A. J. Carlson, Science, 91: 573, June 14, 1940.

In casting about for an explanation of their scarcity, I can suggest only one possibility that would explain their rapid disappearance—that of being eaten by rodents. I have observed on a very few occasions partly eaten antlers with definite teeth-marks left to indicate the gnawing of rodents, presumably mice. Could this be the answer to the disappearance of the antlers? Could antlers serve the same purpose that bones did for Carlson's gray squirrel? Is it likely that other rodents have an "urge" or appetite to eat bones or antlers?

If antlers do actually disappear in this manner, it seems to me, there must be some wide-spread agency consuming them, and consequently they must serve as an important source of supply of minerals. Could it be possible that there is an interrelated dependency between rodents and deer or other antler-shedding ungulates?

It has occurred to me several times that I have found on the range more cases of antlers fastened to the skull than of those that have been shed. While this is clearly a case of memory I wonder if others have had similar experience. If this be true, the obvious implication is that the shed antlers disappear more rapidly than those fastened to the skull at death. If so, is there some change in the composition of the antlers that would make them more palatable to rodents when properly shed than at other times?

ANGUS M. WOODBURY

UNIVERSITY OF UTAH

THE EATING OF BONE BY SQUIRRELS

IN your issue of June 14, Professor Carlson asked for reports on the eating of bone by squirrels. The following note may be of interest. In 1928 I spent a large part of the summer in a cottage on a five-acre island in Lake Temagami, Ontario. The island is densely covered with mixed bush. Lying just outside the cabin was an old moose skull, found a year or two earlier in a stream where it had been long enough to become completely clean; this, combined with subsequent exposure to all weathers, had reduced the fleshy contents to a minimum. During this summer a red squirrel (*Sciurus hudsonicus*) regularly visited the skull twice a day, about 6 A.M. and 4 P.M., and nibbled for a few minutes at projecting parts, especially the upper edge of the orbits. When I first arrived on the island the physiological effects of the breeding season might still have been operative (assuming the animal was a female), but the practice was continued till the end of August, when this could hardly have been the case. I do not want to imply that the visits were invariable, but they were so regular as to be expected, and I have photographs of the animal on the skull. The amount removed each time was very small, but there was a real eating of bone.

A. F. COVENTRY

UNIVERSITY OF TORONTO

FIFTY HARVARD GRADUATES

CERTAIN achievements of the Harvard College Class of 1915 seem worth special consideration just now. This is the class which was graduated into World War I and its social-economic upheavals. It is the class which, having reached its twenty-fifth and mature anniversary, was the principal alumni group at the recent Harvard University graduation exercises. Again a world war was in their minds, and each individual's relations to his society's changes. Seriously they looked backward at their own careers and forward to the careers of their children.

This is what they found in their own pasts:

Seven hundred and two matriculated with the class; 90 have died; 12 have disappeared; 600 are active to-day; some 400 were able or wanted to attend their twenty-fifth class reunion.

Taking "American Men of Science" and "Who's Who in America" as measures of achievement—50 of the 600 survivors are in one or the other of those directories; 9 are in both; 19 are in "American Men of Science." Two are starred in "American Men of Science," one when he was 40 years old, the other when he was 46.

By professions, the 50 break down to 16 in academic work, 5 in medicine, 3 in law, 5 in government service, 6 in finance, 10 in business, 5 in writing.

Oldest in this group is 58 years; youngest 44; average age 47.

Average age of achievement (when a man became assistant professor, published a book, etc.) for the 50 was 33.3 years; for all the scientists, 31.4; for the 9 scientists listed also in "Who's Who" 29.8.

The plurality (24) of these 50 achievers have migrated westward from their place of birth. Seven have traveled eastward; 19 flourish in the neighborhood of birth.

Of the 50, 45 have been married, 7 divorced. Average at first marriage, 27.7. Average marriage age of those with children, 26.8; without children (10 couples) 30.8. Average number of children from productive marriages, 3.1; from all the 50, 2.2.

Of the entire 1915 class of 600, 491 have married. Each averages 2.3 children. The whole class average is 1.9. Achievers are the more family-minded. But one classmate, whom the directories do not list, has nine children. The divorce rate of the achievers is 14 per cent. (7:50), against 9 per cent. (54:600) for the whole class.

MYRON WEISS

NEW YORK CITY

SCIENTIFIC BOOKS

CLADOCERA

Studies on the Physiology, Genetics, and Evolution of Some Cladocera. By A. M. BANTA, with the collaboration of THELMA R. WOOD, L. A. BROWN and LESTER INGLE. x + 285 pp., 170 figs., 16 diagrams. Paper No. 39, Department of Genetics, Carnegie Institution of Washington. 1939.

THIS book tells the general story of results obtained in a series of studies of Cladocera which began in 1911 and continued to 1938. The immediate problem in the beginning was concerned with selection in relation to evolution. This group of animals seemed particularly favorable for a study of small heritable variations because many of the forms show considerable variations in different types of habitats. As the investigation progressed, however, the scope of the studies was enlarged to include a number of problems as shown by the headings of the twelve chapters into which the book is divided; the various topics include discussions of selection, sex intergrades, head mutations, control of male and sexual egg production, genetical studies in sexual reproduction, growth, the effect of environment, and finally the adaptation and evolution of the group.

Limited space permits only brief references to some of the more salient points. With regard to sex intergrades, *Simocephalus exspinosus* showed various stages of intergradedness and some clones produced many more individuals of this type than others; the sex reversals were always from male to female. Many of the intergrade individuals were either sterile or had a low reproductive capacity, thus leading to the conclusion that a sex intergrade stock could not survive in nature. With one possible exception, no sex reversals were found in *Daphnia longispina,* but hermaphroditic individuals were noted occasionally; they also had a low reproductive capacity and probably could not survive under natural conditions.

An excavated-head type of *D. longispina* came from a sex intergrade stock, and the character proved to be heritable in both males and females; it was found in the 250th generation following its appearance. Three elements of the environment were found to have some effect on the sex of cladocerans; temperature and quantity of food acted as general or limiting conditions, while crowding also proved effective in inducing liberal male production. Apparently male production was caused by a lowered rate of metabolism of the mother.

In the genetical studies, some culture lines remained vigorous for long periods of time under parthenogenetic reproduction. A culture of *D. longispina* remained vigorous for 14 years (680 generations), but most lines became weak after prolonged parthenogenesis. Clones of *Moina macrocopa* showed no loss of vigor over a period of 23 years (1,572 generations). Some of the declines in clones may have been due to unfavorable culture conditions, but in some cases they may have been due to dominant or semi-dominant mutations that affected vigor.

The growth studies showed that the normal life of *Daphnia longispina* consisted of 3 juvenile, 1 adolescent, and 10 to 19 adult instars, with a life span of 29 days at 25° C. The growth during the adolescent instar was unusually large, even up to a doubling of the body size. These animals increase in size for about 71 per cent. of their lives, remain at the maximum for 17 per cent. and then have a senescent decline for about 12 per cent.

Marked differences in growth rate were found in different clones and even among individuals of the same clone. Such variations were especially noticeable in the slowly developing dwarf clones which produced individuals phenotypically different from one another, though the members of the clone were all genotypically alike. Apparently the dwarf clones were due to some heritable defect in their assimilative mechanism.

The final chapter deals with the adaptation and evolution of the Cladocera. Parthenogenesis is pointed out as one of the most striking characteristics of the group. It enables them to quickly and abundantly populate temporary habitats, such as seasonal pools, as well as permanent bodies of water when conditions are favorable. When crowding or other unfavorable conditions overtake them, they are able to reproduce sexually and form resistant eggs which are able to withstand severe environmental conditions and thus provide for the survival of the various forms.

The book is a fitting climax to the arduous and painstaking studies that have been carried on for such a long period of time.

CHANCEY JUDAY

UNIVERSITY OF WISCONSIN

REPORTS

THE NATIONAL RESEARCH COUNCIL COMMITTEE ON MATHEMATICAL TABLES AND AIDS TO COMPUTATION

SINCE this committee has been especially active during the past twelve months, it seems desirable that some account of this activity and of the committee's plans should be more generally known. At present its chief aim is to prepare a series of reports on published and unpublished mathematical tables of importance for current research in different fields. This does not, of course, imply a survey of every table in each field, but only those of special importance for research at the present time, though it may occasionally be found that old tables of this nature have not been replaced by anything of recent date.

Each report is to contain the following three major divisions:

I. Descriptive survey of all tables in accordance with a carefully prepared plan of classification of the field.

II. Bibliographic details of every table, published or unpublished, which is referred to in the survey. These are alphabetically arranged and refer to every edition and every translation.

III. List of all known errata in every table listed. This feature must frequently be of exceptional value to the worker.

From the descriptive survey one may at once learn every table in any particular part of a field and the exact range of each table. The bibliography indicates the periodicals, books, pamphlets or manuscripts where the tables may be found, and also the location of every manuscript. The new edition of the "Union List of Serials" will soon indicate the libraries of the United States and Canada where the serials mentioned may be found. The committee made up a list of 37 libraries (2 in Canada and the others in 22 states) whose exact holdings, of all books and pamphlets mentioned in each report, are to be indicated.

The present membership of the committee is as follows:

Executive Committee:

Professor R. C. Archibald, *chairman*, Brown University
Professor H. Bateman, California Institute of Technology
Doctor L. J. Comrie, Scientific Computing Service Ltd., London, England
Professor H. T. Davis, Northwestern University
Professor D. H. Lehmer, University of California
Professor H. S. Wilks, Princeton University

Professor S. H. Caldwell, Massachusetts Institute of Technology
Professor W. G. Cochran, Iowa State College of Agriculture and Mechanic Arts
Professor A. T. Craig, State University of Iowa
Professor C. Eisenhart, University of Wisconsin
Professor J. D. Elder, University of Michigan
Professor P. W. Ketchum, University of Illinois
Doctor A. N. Lowan, U. S. Works Progress Administration, 475 Tenth Ave., New York City
Doctor J. C. P. Miller, University of Liverpool, England
Doctor W. A. Shewhart, Bell Telephone Laboratories, New York City
Doctor G. R. Stibitz, Bell Telephone Laboratories, New York City
Professor I. A. Travis, University of Pennsylvania

The present 22 sections (A . . . Z) of different fields, and the six subcommittees already chosen to survey twelve of these sections are as follows:

A. Arithmetic. Mathematical Constants
B. Powers
C. Logarithms
D. Circular Functions
E. Hyperbolic and Exponential Functions
  Professor Davis, *chairman*
  Professor Elder
  Professor Ketchum
  Doctor Lowan

F. Theory of Numbers
  Professor Lehmer

G. Higher Algebra
  Professor Lehmer

H. Numerical Solution of Equations
J. Summation of Series

I. Finite Differences
K. Statistics
  Professor Wilks, *chairman*
  Professor Cochran
  Professor Craig
  Professor Eisenhart
  Doctor Shewhart

L. Higher Mathematical Functions
M. Integral Tables
  Professor Bateman

N. Interest and Investment
O. Life Insurance
P. Engineering
Q. Astronomy
R. Geodesy
S. Physics
T. Chemistry
U. Navigation

Z. Calculating Machines and Mechanical Computation
  Doctor Comrie, *chairman*
  Professor Caldwell
  Professor Lehmer
  Doctor Miller
  Doctor Stibitz
  Professor Travis

It is expected that in the near future other subcommittees will be organized for dealing with further sections. Professor Lehmer's Report on Section F—Theory of Numbers is now in the press and will probably occupy about 175 pages.

I should be especially glad to receive information from any one with reference to mathematical manuscript tables, of value for our survey, which may be in public or private hands.

I have stated that the chief aim of the committee was to prepare for publication by the National Research Council a series of reports such as are described above. But another aim of almost equal importance is to publish a series of new mathematical tables which the committee has reason for believing to be of importance for different fields of research. In order to make such publications possible the Rockefeller Foundation, last May, appropriated $15,000 to the National Research Council to be used for the establishment in the Division of Physical Sciences of the Council of a revolving fund "for the publication of mathematical tables and aids to computation and bibliography of such tables," under the direction of the Committee on Mathematical Tables and Aids to Computation.

Raymond Clare Archibald

Brown University,
June 26, 1940

SPECIAL ARTICLES

RADIO-IRON IN PLASMA DOES NOT EXCHANGE WITH HEMOGLOBIN IRON IN RED CELLS[1, 2]

Radio-iron gives the investigator a relatively simple and accurate method of tracing the course of iron absorption and transfer within the body. When iron is absorbed in the anemic dog it heaps up rapidly in the blood plasma,[3] reaches a peak and falls close to the base line in 6 to 12 hours. Within 4 hours after feeding, radio-iron is found in significant amounts in the hemoglobin of red cells of the anemic dog.[4] When values shift with this rapidity, obviously we must be certain that the iron within the hemoglobin of these circulating cells does not exchange with the plasma radio-iron in the dog under investigation. The following experiments bear on this important point and give evidence that the iron bound in hemoglobin is fixed and incapable of exchange with plasma radio-iron or artificial solutions of radio-iron.

The following experimental procedure was employed. Iron containing the radioactive isotope was fed to a fasting anemic dog. One and a half hours later, 90 ml of blood was withdrawn into 20 ml of isotonic oxalate. Red cells were removed by centrifugalization. One aliquot of 10 ml of plasma was ashed for radioactive iron determination. Six other aliquots were added to washed red blood cells obtained from 10 ml of blood of animals whose blood levels ranged from severe anemia to normal. The suspensions were kept at 37° C. for 24 hours with frequent agitation. The cells were removed in the centrifuge and washed three times with saline. Cells were laked and stroma precipitated by re-establishing isotonicity followed by centrifugalization. The supernatant solution of hemoglobin was ashed for radioactive iron determination.

Activity determinations were made using the Geiger-Müller counter as described in previous publications.[3]

The control plasma aliquot had an activity of 5.3 counts per minute above the background of 3.7 counts per minute on our scale-of-four counter.

In each case measurement of activity of the iron separated from the hemoglobin after the exchange experiment showed close to background rate of counting, indicating that no exchange within the accuracy of measurement had occurred.

From statistical considerations it is considered that in these individual experiments exchange could have been as high as 15 per cent. without having been detected, although in the average of six experiments it is certainly much less than this.

TABLE 1

Lack of Exchange between the Iron of Hemoglobin in Red Cells and Physiologically Bound Plasma Radio-Iron

Dog	Hematocrit	Hemoglobin level	Activity found counts per min.		Remarks
			Hemoglobin	Plasma	
	%	gm %			
39–196	51.7	18.0	0.2	4.4	Normal adult
39–53	28.9	8.0	0.0	4.8	Anemic
39–144	32.2	10.5	0.0	5.5	Anemic, protein depleted
37–227	18.4	5.4	0.0	4.8	Anemic
39–80	17.3	4.8	0.0	5.9	Anemic, bile fistula
39–169	32.5	10.9	0.4	6.1	Anemic, receiving liver in diet

Control plasma shows an activity of 5.3 counts per minute.

An experiment was carried out to determine whether there was any exchange between hemoglobin in solution and inorganic iron in solution. Ninety ml of

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[1] *From the Departments of Pathology and Radiology*, the University of Rochester School of Medicine and Dentistry, Rochester, N. Y.

[2] We are deeply indebted to Professor E. O. Lawrence and members of the Radiation Laboratory of the University of California for the radioactive iron used in these experiments, and in particular to Dr. M. D. Kamen, who was directly responsible for preparing the isotope.

[3] P. F. Hahn, W. F. Bale, E. O. Lawrence and G. H. Whipple, *Jour. Exp. Med.*, 69: 739, 1939.

[4] L. L. Miller and P. F. Hahn, *Jour. Biol. Chem.*, 134: 585, 1940.

blood from dog 38-112, an anemic animal with no circulating radioactive iron, was centrifugalized. Plasma was discarded. The cells were laked in distilled water and the stroma precipitated partially by the addition of 18 per cent. sodium chloride. The supernatant solution, largely hemoglobin, was separated and 2 ml of iron labelled with the radioactive isotope in the form of ferric ammonium citrate were added. After standing in the refrigerator for 24 hours the mixture was poured into aluminum cream to precipitate remaining stroma and any other protein material other than hemoglobin. Perhaps 15 per cent. of the original hemoglobin was lost in this step. The filtrate was poured into an equal volume of 10 per cent. trichloroacetic acid to precipitate hemoglobin and this precipitate was washed and ashed for determination of radioactivity.

EXPERIMENTAL DATA

Iron content of hemoglobin from 90 ml of blood	22 mg
Labelled iron added as ferric ammonium citrate	0.34 mg
Activity of radioactive iron added	66 counts per min.
Net activity of radioactive iron in hemoglobin	0.1 counts per min.

The amount of labelled iron found in the hemoglobin is within the experimental error. It is estimated that radioactive iron equal in activity to 0.4 counts per minute might have been present and escaped detection. This sets an upper limit of 1 per cent. on the amount of exchange which might have taken place and escaped detection under the conditions of the experiment.

These findings are supported by other experiments in which solutions of hemoglobin were tested with artificial solutions of radio-iron in plasma. There was no evidence of any exchange between the hemoglobin iron and the radio-iron in solution. These experiments were done before the final tests recorded in Table 1.

P. F. HAHN
W. F. BALE
J. F. ROSS
R. A. HETTIG
G. H. WHIPPLE

VISCOSITY AND THE SHAPE OF PROTEIN MOLECULES

IN some recent publications,[1, 2, 3, 4] attempts have been made to interpret protein viscosity data in terms of the asymmetry of the molecules. This has been done by applying equations developed by Burgers[5] and Eisenschitz,[6] or by Kuhn,[7] on the assumption that there is no orientation of the molecules. The discrepancies between these values for the asymmetry and the values obtained by applying the equations of Perrin[8] to sedimentation velocity and diffusion data are considerable. It has been suggested that the differences arise from the failure to consider the effects of hydration. Recently the hydrodynamic behavior of ellipsoids has been reconsidered by Simha.[9] The results obtained seem to yield better agreement for the asymmetries of various proteins than previous equations without any assumption of hydration.

In the expression for the specific viscosity at infinite dilution,

$$\eta/\eta_0 - 1 = \nu c \qquad (1)$$

(where c is the volume fraction of the solute), ν is a function of the axial ratio, ρ, of an ellipsoid of revolution. Table I gives the numerical values of the factor ν for values of $1/\rho$ and ρ from 1 to 300. These values have been applied to the same viscosity data as those used by Polson[1] and by Mark and Simha.[2] In Table II the axial ratios are compared with those from sedi-

TABLE I

$1/\rho$ or ρ	ν elongated	ν flattened	$1/\rho$ or ρ	ν elongated	ν flattened
1.0	2.50	2.50	20.0	38.6	14.80
1.5	2.63	2.62	25.0	55.2	18.19
2.0	2.91	2.85	30.0	74.5	21.6
3.0	3.68	3.43	40.0	120.8	28.3
4.0	4.66	4.06	50.0	176.5	35.0
5.0	5.81	4.71	60.0	242.0	41.7
6.0	7.10	5.36	80.0	400.0	55.1
8.0	10.10	6.70	100.0	593.0	68.6
10.0	13.63	8.04	150.0	1222.0	102.3
12.0	17.76	9.39	200.0	2051.0	136.2
15.0	24.8	11.42	300.0	4278.0	204.1

TABLE II

Protein	f/f_0	ν	$1/\rho$, elongated Diffusion	$1/\rho$, elongated Viscosity	ρ, flattened Diffusion	ρ, flattened Viscosity
Egg albumin ...	1.17	5.7	3.8	5.0	4.0	6.7
Serum albumin..	1.25	6.5	5.0	5.6	5.4	7.7
Hemoglobin	1.16	5.8	3.7	4.6	3.9	6.0
Amandin	1.28	7.0	5.4	6.0	6.0	8.5
Octopus hemocyanin	1.38	9.0	7.2	7.3	8.2	11.4
Gliadin	1.60	14.6	10.9	10.5	13.6	21
Homarus hemocyanin	1.27	6.4	5.2	5.5	5.8	7.5
Helix pom. hemocyanin	1.24	6.4	4.8	5.5	5.2	7.5
Serum globulin .	1.41	9.0	7.6	7.3	8.9	11.4
Thyroglobulin ..	1.43	9.9	7.8	7.9	9.2	12.7
Lactoglobulin ..	1.26	6.0	5.2	5.1	5.7	6.9
Pepsin	1.08	5.2	2.5	4.5	2.6	5.8
Helix hemocyanin pH 8.6	1.89	18.0	16.6	12.0	23.9	26

---

[1] A. Polson, *Koll. Zeits.*, 88: 51, 1939.

[2] Mark and Simha, *Nature*, 145: 571, 1940.

[3] V. L. Frampton and H. Neurath, SCIENCE, 87: 468, 1938.

[4] M. A. Lauffer, SCIENCE, 87: 469, 1938.

[5] J. M. Burgers, "Second Report on Viscosity and Plasticity," Amsterdam, 1938.

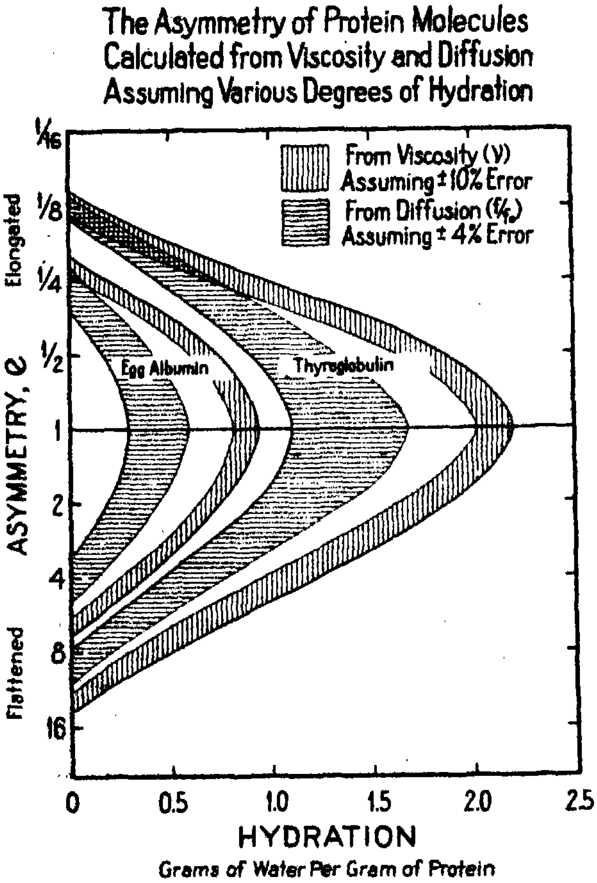
[6] R. Eisenschitz, *Zeits. physik. Chem.*, A163: 133, 1933.

[7] W. Kuhn, *Zeits. physik. Chem.*, A161: 1, 1932.

[8] F. Perrin, *Jour. Phys. et Rad.*, 7: 1, 1936.

[9] R. Simha, *Jour. Phys. Chem.*, 44: 25, 1940.

mentation and diffusion. The agreement seems to be generally good on the assumption that the protein molecules can be approximated by rigid elongated ellipsoids.



In an attempt to evaluate the importance of hydration and to determine whether any choice can be made between the elongated and flattened shapes, values of ρ were calculated from viscosity and from sedimentation and diffusion, assuming that the protein carried varying amounts of water. It also seemed desirable to consider the influence of experimental error, so that the values of f/f_0 were taken to be subject to ± 4 per cent. error, and values of ν to ± 10 per cent. error. The areas included between pairs of such curves would then include the possible choices for shape and hydration. Such curves for egg albumin[10] and thyroglobulin are given in Fig. 1. They were chosen as well-characterized examples of fairly symmetrical and fairly asymmetrical molecules. The shape of these curves is such that they never cross sharply, but it can be said that, for these two cases, hydration greater than 0.5 grams of water per gram of protein, and the flattened shape, seem relatively improbable.[11]

It should be further emphasized that all the equations mentioned above only apply to measurements of the viscosity which are made in the region of complete Brownian movement. Any orientation will reduce ν, and hence $1/\rho$ or ρ if these equations are misused. This may be well illustrated by the case of tobacco mosaic virus, where measurements in capillary tube viscometers give values of ν of about 80.[3, 4] However, this must be much too low, as it is known that double refraction of flow is obtained under such conditions of flow. Robinson[12] has made measurements in a Couette viscometer and found that ν approaches 1,500 as the velocity gradient approaches zero. This would correspond to an axial ratio of about 160, assuming a rod-like shape.

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[10] The value of ν chosen for egg albumin for this calculation was 5.4, rather than 5.7 as used by Polson. The choice of this value is discussed by Oncley, *Proc. N. Y. Acad. Sci.*, in press.

[11] For a discussion of solvation on the basis of viscosity measurements, see also H. Mark and R. Simha, *Jour. Phys. Chem.*, in press.

[12] *J. R.* Robinson, *Proc. Roy. Soc. Lond.*, A170: 519, 1939.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN ELECTRONIC RELAY FOR HEAT CONTROL[1]

THERE are a large number of biological and chemical processes whose study requires the temperature of the materials to be held within very narrow limits. While several methods for temperature control have been described they have the disadvantage of being rather elaborate and expensive when the temperature is to be held to 0.02° C. To overcome these disadvantages, we developed the electronic relay whose circuit is given in Fig. 1. It controls a bath temperature to 0.02° C.,[2] requires only a 115-volt power source which can be either a-c or d-c, and permits only a few microamperes to pass through the thermoregulator contacts. The parts of the apparatus were bought at a radio shop for less than six dollars.

The device operates as follows: When the temperature of the thermostat is too low, the circuit through its thermoregulator is open; there is thereby no electrical connection between points A and B, and the control grid of the type 25L6 tube is at approximately the same potential as the cathode. Under this condition the tube has a low plate resistance, the plate current is very large and the relay (Dunco, Catalogue No. ABTX1) is energized, causing the relay contacts to close. The closed contacts permit current to flow through the heater in the thermostat, thus raising its temperature. When the temperature has been increased sufficiently, the contacts in the thermoregulator close the electrical connection between points A and B and thereby make the control grid about 25 volts negative with respect to the cathode. Under this condition the tube has a very high plate resistance, causing the plate current to fall to practically zero. The relay is thus de-energized, its contacts open, and the heating current is interrupted.

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[1] Contribution from the Department of Electrical Engineering and the Research Laboratory of Physical Chemistry, No. 451, Massachusetts Institute of Technology.

[2] Heldt, *Jour. Am. Chem. Soc.*, 61: 3455, 1939.

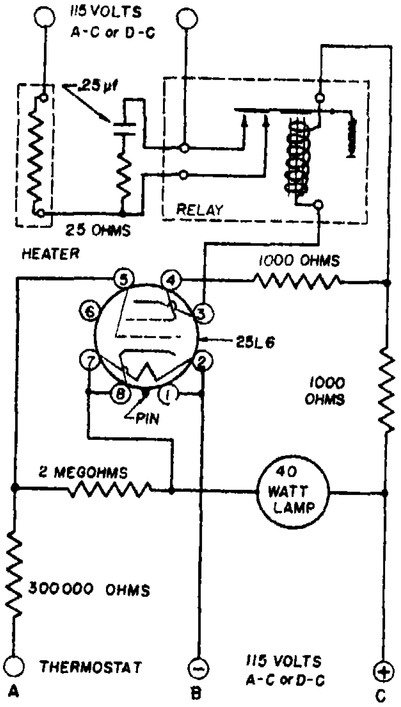

FIG 1

The 0.25 μf capacitor is rated for 400 volts d-c and the resistors for two watts. The 25L6-GT tube and its octal socket are sketched as viewed from the tube. The numbers are added to aid in assembling the apparatus simply by reference to the pin fixing the position of the tube in the socket whose No. 6 prong is not used. If it is possible, the point B and the thermostat should be grounded. The current through the heater may be controlled by inserting lamp bulbs or other resistors in series with it. The relay contacts are rated to carry six amperes.

When the device is put into operation and the line voltage applied, the filaments of the tube will require about a minute to reach their operating temperature. The relay will then close if the contact between A and B is open and the tension in the relay spring has been properly adjusted. It is probable that the spring tension will have to be adjusted when the relay is first put into operation, and readjusted if the source is changed from a-c to d-c. Except for a semi-monthly check, the relay needs no attention after this initial adjustment.

The first 25L6 tube lasted nearly two years. The remainder of the apparatus is still in use after operating almost continuously for over three years.

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Lawrence J. Heidt
Massachusetts Institute of Technology

INEXPENSIVE MICROPHOTOGRAPHIC RECORDS

In a recent issue of Science[1] it is suggested that a nail be driven through the lens of a Univex camera in order to obtain a focus with a microscope. I have been using a Univex camera without destroying the lens and without using up the entire film for one picture. If the camera is placed in the same position as the eye after focussing the microscope the camera will be in focus. By pasting a paper or tin tube on the front of the camera it may be placed in position by sliding this tube down over the eye end of the microscope. It is necessary to remove the back of the camera and use ground glass only while pasting on the tube, in order to center it. The tube may be pasted on with so-called "liquid solder" or any other quick-drying nitrocellulose adhesive. If the tube is painted black inside the camera may be used to take pictures of apparatus or experimental animals as well as for photomicrographs.

A label in lead pencil is photographed with the specimen. The time of exposure is usually about 1 second, and about 5 seconds is all that is required to place the camera, make the exposure and remove the camera.

J. F. McClendon
Hahnemann Medical College,
Philadelphia

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[1] E. M. Abrahamson, Science, 91: 510, 1940.

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THE NATIONAL ROSTER OF SCIENTIFIC AND SPECIALIZED PERSONNEL

By LEONARD CARMICHAEL

PRESIDENT OF TUFTS COLLEGE

THE National Roster of Scientific and Specialized Personnel is a project of the United States Government, planned to make available in one central office an index of all American citizens who have special scientific or professional skills which may be of importance to the nation in periods of emergency and in normal times.

A somewhat similar register has been completed in England under the sponsorship of the Royal Society. There is no doubt that similar catalogues are available in the totalitarian nations.

The American Roster of Scientific and Specialized Personnel is being developed as a means of recording in an accurate way one of the important areas of the human resources of the nation. It is peculiarly appropriate, therefore, that the national roster is being developed by the federal government as a joint project of the National Resources Planning Board and of the Civil Service Commission. The latter agency is especially concerned in the matter because its executives have seen clearly that the modern advance of scientific and technical specializations has rendered it necessary that the nation should be able to call upon its specialized personnel in an intelligent and efficient manner.

Thus, the fundamental idea behind the new roster is conservation. It is recognized by all that the services of experts may be crucial in preserving the welfare of the nation. A chemist whose work has been done in some specialized and relatively obscure field may suddenly become the one man in the country able to devise a means of protection against some new chemical weapon. A specialist in an obscure dialect of a foreign language may possess a skill which will have far-reaching significance in an emergency. The conservation of specialized work now in progress is also important to the nation. It is most desirable not to disturb an important cooperating group of scientists in a certain laboratory if similarly trained experts not so engaged can be found elsewhere.

All these facts point to the desirability and, indeed, the necessity of a national roster of the sort now being compiled. In England, because of the smaller size of the country and because of the nature of its university system, such a roster would have seemed much less necessary than in the United States, but the scientific register completed there last year has, according to published accounts, proved to be of great national value.

It is significant that the demand for the national roster in America arose from governmental agencies concerned with national resources and with Civil Service appointments on the one hand, and on the other hand from the great non-governmental councils which represent the specialized scientific and professional personnel of the country.

The organization meeting of the national roster was held in the office building of the Department of State in Washington on June 28. Frederic A. Delano, president of the National Resources Planning Board, was in the chair. Present also were Thomas C. Blaisdell, Jr., of the National Resources Planning Board, and Arthur S. Flemming, Civil Service Commissioner. Among others present were the following: Representing the National Research Council, Ross A. Harrison and Albert L. Barrows; representing the American Council on Education, W. H. Cowley; representing the American Council of Learned Societies, D. H. Daugherty and H. G. Doyle; and representing the Social Science Research Council were R. T. Crane and Carl C. Brigham. Charles F. Ascher and Joseph G. Harris also attended. It was announced that Leonard Carmichael had been chosen as chairman of the consulting committee and director of the project, and that James C. O'Brien, an experienced executive of the Civil Service Commission, had been made executive officer of the new project. J. S. Nicholas has subsequently been appointed to represent the National Research Council.

The committee decided to consider that the ultimate field to be embraced by the roster should be the inclusion of all scientific and professional workers in the United States. When such a comprehensive classification is worked out, it will complement and supplement any general register of American personnel in all walks of life if such a general register is later established. Again to refer to the English precedent, it may be said that in spite of the general register in that country, it was recognized that a separate and detailed index of the specialized personnel of the nation was necessary.

The ultimate scope of the register having thus been agreed upon, it was at once recognized that the achievement of this aim could not be realized at once. Two criteria were then agreed upon to determine the professional areas in which the register should then begin its work: (1) it was decided that the fields of greatest present need, as already expressed by agencies of the government, should determine the sectors in which information should first be collected. (2) it was also decided that, given two fields of relatively equal significance for the present needs of the government, that field should first be catalogued in which personnel records are at the present time least complete.

Incidental to starting work upon the register, the Civil Service Commission is now engaged in collecting lists of the membership of all scientific and professional societies of the country. In collecting these lists, the constituent societies of the National Research Council and the other councils of learned societies are being especially canvassed.

The register itself is planned as a card index punched with the appropriate information concerning each individual in the register. The preparation of punch cards to make the analysis of large and divergent categories of information analytically available is a technical problem. An expert administrative staff will direct this aspect of the development of the register. It is agreed, in this connection, that the existing federal codes of occupations, such as that prepared by the Civil Service Commission in its project looking to the coding of all positions in the federal service, shall be used in all cases as a basis for the new and highly specialized classification required in the register.

The necessary information concerning individuals is to be secured by sending each professional man a general questionnaire to secure information concerning geographical location, age, sex, training, etc., and also a specialized questionnaire or check-list intended to cover in detail his own special field, as, for example, physics. The special check-lists or code analyses in each of the specialized fields are to be drawn up by experts in each field in relation to existing empirical data concerning the actual work of men in these fields. This information will be called for in a manner which will make it possible to attach it directly to the existing codes now in use in the government services. In securing this information, the hobbies of scientific and professional men will not be neglected. The English experience has shown that, for example, a biologist who has as his hobby the designing of special radio circuits may be more valuable to the nation as a communications engineer than in his own special field of professional competence.

It is recognized that selection of men for important governmental posts and, indeed, for less important specialized activities can not be reduced to a mechanical card-sorting procedure. It is therefore planned to organize committees in each of the specialized fields based upon nominations of those working in these fields. These special committees of experts are to be asked in certain instances to evaluate the names of individuals who are presented to them by the automatic process of the punch-card technique. These special committees are also to be charged with the duty of protecting present educational and research endeavors which are performing important public services to the maximum degree possible.

Fundamentally, the aim of the national roster is the development of a means for the efficient and rapid but appropriate use of the specialized brains of America in the service of the nation. As the English commission has said: "The National Service Department is fully alive to the consequences of the errors of assignments made in the war of 1914–18 and is anxious to avoid repetition of those errors and to insure that each man who offers his services is assigned to that task for which his knowledge, training and capacities best fit him."

Once started and organized, it seems that the value of the roster to many constructive activities of peace time, especially in connection with modern personnel and employment services, will be obvious. It seems clear that with the passing of the present emergency, this roster should not be abandoned, but rather, maintained as a continuing and always up-to-date census of the specialized brains of America. Even in a complete and continuing form, the development and maintenance of such a register will not be expensive in comparison with some of the other projects already undertaken for the preservation and effective use of our natural resources. Moreover, the procedures which will be based upon the use of the roster are at once effective and truly democratic.

The time has come when our nation must be efficient. The National Roster of Scientific and Specialized Personnel is certainly a necessary tool of an effective democracy.

THE PRODUCTION, RETENTION AND ATTRACTION OF AMERICAN MEN OF SCIENCE[1]

By Professor E. L. THORNDIKE

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THE facts reported in this article are based on the persons listed on 1,500 of the pages of the 1938 edition of "American Men of Science." Wherever a number is stated as for all the persons listed in that book, it is (unless otherwise stated) obtained by multiplying the number obtained from these 1,500 pages by 1.0667. The divergences between the rates reported and those which a complete count of all 1,600 pages would have produced are of no consequence.

Column 1 of Table 1 states the number of A.M.S. entries residing in each state. Column 2 of Table 1 states the number of A.M.S. entries residing in each state per million population in 1930. The median is 189. There is a wide variation, from 46, 57 and 67 for Miss., Ark. and Ala. to 461 for Nev., 482 for Md. and 1,179 for Del. Six states are below 100 and nine are above 300.

Column 3 of Table 1 states the number of members of the A.A.A.S. reported for 1934 (*Proceedings* of the A.A.A.S., Vols. 82 to 87). Even without allowance for the number of memberships by institutions and by amateurs not listed in American Men of Science, the differences between column 2 and column 3 show regrettably large numbers of men of science who fail to cooperate with the American Association.

Column 4 states the percentage which the A.A.A.S. membership is of the A.M.S. enrolment for each state. It has a median at 61, and ranges from 26 for Delaware to 96 for Connecticut; 43 of the states have percentages from 40 to 80.

Column 5 states the number of A.M.S. persons born in each state. When this number × 1,000,000 is divided by the sum of the 1890 and 1900 populations the result is as given in Column 6. The numbers in Column 6 may be called approximate relative birth-rates. They are by no means perfect as measures of the comparative productivity of the states, but the errors are small in comparison with the differences among the states. It would be impossible to obtain for each state and each period the percentage of those born in the state who would, before they died, or before they reached some specified age, be enrolled in any specified list.

The birth-years of American men of science are

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[1] The work reported here was one item of a project supported by the Carnegie Corporation.

TABLE 1

AMERICAN MEN OF SCIENCE IN THE 48 STATES

	Number residing 1	Number residing per million of 1930 population 2	Number of members of the A.A.A.S. 3	Percentage which A.A.A.S. membership is of A.M.S. 4	Number born 5	Number born × 1,000,000/sum of 1890 + 1900 populations 6	Number born per 100,000 white population in 1890 7	Percentage of those born in the state and residing in the U.S.A. residing in the state of birth 8	Per cent. which the entry of column 8 is of the corresponding percentage for all persons born in the state 9	Number (of A.M.S.) born in other states residing in the specified state 10	100,000 × the entry of column 10 divided by the number of all persons born in other states residing in the specified state 11	Number of A.M.S. born in foreign countries 12	Number of A.M.S. born in foreign countries × 100,000 divided by the total number of foreign-born in the specified state in 1930 13
Ala.	177	67	34	51	157	47	19	23	30	132	43	8	50
Ariz.	131	301	248	82	20	95	36	17	24	114	57	12	18
Ark.	105	57	23	40	127	52	16	10	15	90	18	3	28
Cal.	1,817	320	257	80	555	206	50	52	57	1,302	50	225	21
Colo.	288	278	179	64	324	340	80	12	19	229	45	19	19
Conn.	577	359	343	96	460	278	63	18	23	422	138	60	18
Del.	281	1,179	302	26	49	139	35	18	26	247	377	21	123
Fla.	243	165	96	58	45	49	20	13	16	211	32	16	23
Ga.	239	82	40	49	177	44	18	31	41	179	60	7	49
Id.	86	193	88	46	63	252	77	9	14	77	35	4	12
Ill.	1,604	210	149	71	1,758	203	47	22	30	1,039	67	182	15
Ind.	515	159	91	57	1,138	242	53	17	24	333	48	39	27
Iowa	474	192	119	62	1,107	267	58	11	18	321	65	31	18
Kan.	314	167	94	56	695	240	50	10	16	223	34	24	30
Ky.	183	70	49	70	315	79	20	16	23	126	43	9	41
La.	255	121	90	74	122	49	22	39	48	189	70	18	49
Me.	148	186	104	56	347	256	53	13	18	94	150	11	11
Md.	787	482	274	57	503	226	61	27	35	572	177	70	73
Mass.	1,501	353	254	72	1,516	301	68	30	37	882	173	161	15
Mich.	884	183	112	61	896	198	43	22	27	598	53	90	11
Minn.	561	219	134	61	642	210	50	22	30	380	75	53	14
Miss.	92	46	22	48	150	53	28	21	28	58	23	2	25
Mo.	514	142	112	79	844	146	33	15	23	347	39	44	29
Mont.	110	205	121	59	96	249	75	9	14	95	40	6	8
Neb.	189	137	103	75	434	204	41	10	15	131	35	15	18
Nev.	42	461	329	71	15	167	38	29	58	36	78	1	7
N. H.	139	299	189	63	212	269	56	10	15	103	101	14	17
N. J.	1,076	266	165	62	450	135	32	18	21	831	79	153	18
N. M.	87	205	142	69	30	84	21	11	16	78	54	6	25
N. Y.	3,937	311	264	85	2,612	197	44	40	48	2,329	169	546	17
N. C.	369	116	57	49	268	76	25	20	35	269	85	22	245
N. D.	73	107	69	64	95	186	52	7	10	60	33	6	6
Ohio	1,331	200	134	67	1,775	227	50	23	29	812	60	111	17
Okla.	277	116	55	47	112	107	?	16	22	235	20	23	75
Ore.	225	230	128	54	159	218	53	13	18	186	41	20	18
Pa.	1,846	192	136	71	1,883	163	37	30	33	1,077	112	193	16
R. I.	147	214	163	76	163	211	48	15	19	107	91	15	9
S. C.	139	80	40	50	205	82	44	15	20	99	73	8	149
S. D.	71	102	42	41	192	256	59	3	4	62	27	3	5
Tenn.	271	104	63	61	240	63	18	17	24	210	50	20	151
Tex.	583	100	67	67	429	81	25	34	40	411	36	27	8
Utah	143	282	144	51	240	492	117	32	44	62	79	6	13
Vt.	78	217	117	54	195	288	59	10	15	53	89	6	14
Va.	443	183	111	61	439	125	43	25	35	297	90	32	131
Wash.	290	186	100	54	204	233	60	14	18	236	33	27	11
W. Va.	182	105	60	57	192	111	26	21	27	131	38	11	21
Wis.	540	184	119	65	855	227	51	16	21	357	94	43	11
Wyo.	70	310	102	33	37	139	63	11	20	65	50	2	9

approximately as shown in Table 2 for a random sample of 2,000 of them. The rates of Column 6 of Table 1 will be more or less unjust to certain states which had relatively larger populations in 1890 and 1900 than over the whole period during which the persons enrolled were born.

TABLE 2

Age Distribution of American Men of Science. Number Born among Two Random Thousands of American Men of Science, 1938

	I	II	Av.
Before 1860	3	10	6.5
1860–1864	22	26	24
1865–1869	28	43	35.5
1870–1874	75	70	72.5
1875–1879	55	81	68
1880–1884	92	88	90
1885–1889	113	127	120
1890–1894	148	133	140.5
1895–1899	153	156	154.5
1900–1904	166	148	157
1905–1909	124	104	114
1910 or later	21	14	17.5
			1000.0

For the sake of those who are interested in rates based on the white population, Column 7 of Table 1 shows the number of A.M.S. entries per 100,000 white population in 1890.

Column 8 of Table 1 states the percentage which the number born in a state and residing in it in 1938 is of the number born in it and residing anywhere in the United States. The mobility of American men of science is very great, the average percentage residing in the state of birth being 19, about a fourth that for the general population. The variation among states is wide, the percentages ranging from 3 for South Dakota to 52 for California, four being less than 10 and eight being 30 or more.

It is for certain purposes more important to know a state's retention of its future men of science in comparison with its retention of the generality of those born in it. Column 9 of Table 1 reports the ratio, *per cent. retained of A.M.S./per cent. retained of all persons born,* for each state. The variation is great.

The attraction of American men of science to each state is shown by columns 10 to 13. Column 10 states the number of A.M.S. men born in other states residing in each state. Column 11 states the ratio of this number to the total number of residents of the state who were born in other states. The variation among states in this ratio is very great. For every 100,000 immigrants from other states Arkansas has 18 men of science, Mississippi has 23, Oklahoma has 20 and South Dakota has 27, whereas Delaware, Maryland, Massachusetts and New York have respectively 377, 177, 173 and 169. The differences are obviously connected with differences in the amount of manufacturing relative to agriculture, but that is not the whole story. For Iowa, Louisiana, Maine, Minnesota, New Hampshire, North Carolina, South Carolina and Utah are high, Alabama is below Georgia, Pennsylvania is below Maryland, and there are other discrepancies. The number of men of science born in foreign countries is given for each state in column 12, and the ratio of this number to the total number of foreign-born residing in the state is given in column 13.[2]

Table 3 presents the facts of columns 6, 9, 11 and 13 as deviations + or – from the score of the median state for the fact in question.[3]

TABLE 3

The Facts of Columns 6, 9, 11 and 13 of Table 1 Expressed as Deviations from the Score of the Median State for the Fact in Question

	6 Birth	9 Retention	11 Attraction from other states	13 Attraction from foreign countries
Ala. ...	–17	7	–4	16
Ariz. ...	–12	1	1	0
Ark. ...	–17	–8	–12	5
Cal.	1	34	–2	2
Colo. ..	16	–4	–3	1
Conn. ..	9	0	26	0
Del	–7	3	102	53
Fla. ...	–17	–7	–7	3
Ga.	–17	18	2	16
Id.	6	–9	–6	–3
Ill.	0	7	4	–2
Ind. ...	5	1	–2	5
Iowa ..	8	–5	3	0
Kan. ...	4	–7	–7	6
Ky.	–14	0	–4	12
La.	–17	25	5	15
Me.	6	–5	30	4
Md.	3	12	39	27
Mass. ..	11	14	37	–2
Mich. ..	0	4	–1	–4
Minn. ..	1	7	6	–2
Miss. ..	–16	5	–10	4
Mo.	–6	0	–5	5
Mont. ..	5	–9	–5	–5
Neb. ...	0	–8	–6	–3
Nev. ...	–4	35	7	–6
N. H. ..	8	–8	15	–1
N. J. ..	–7	–2	8	0
N. M. ..	–13	–7	0	3
N. Y. ..	0	25	36	–1
N. C. ..	–14	12	10	113
N. D. ..	–2	–13	–7	–6
Ohio ...	3	6	2	–1
Okla. ..	–10	–1	–11	28
Ore. ...	2	–5	–4	0
Pa.	–4	10	18	–1
R. I. ...	1	–4	11	–5
S. C. ..	–13	–3	6	65
S. D. ..	6	–19	–9	–7
Tenn. ..	–15	1	–2	66
Tex. ...	–13	17	–6	–5
Utah ..	33	21	8	–3
Vt.	10	–8	11	–2
Va.	–8	12	11	65
Wash. .	4	–5	–7	–4
W. Va. .	–10	4	–5	2
Wis. ...	3	–2	12	–4
Wyo. ..	–7	–3	–2	–5

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[2] In this case, the numbers are for a complete count of all 1,600 pages of "American Men of Science."

[3] The scales for Table 3 are such that in each case 20 equals approximately the range required to include 32 of the 48 states.

The ranks of the states in the production, retention and attraction of men of science more than men in general seem chaotic to a casual inspection of Table 3. And closer study does not greatly alter this impression. Except for Maryland, no state is above the median in all four respects; and the status of Maryland may be influenced by its being suburban to Washington and surely is influenced by the presence of a great private university and hospital. Except for North Dakota and Wyoming no states are below the median in all four, and their low rank in births may be due to the use of the 1890 + 1900 populations as a base. Their populations in 1860, 1870 and 1880 were relatively small. There is a tendency for the states of the West and Northwest to produce many men of science; but they do not retain them in competition with manufacturing states, nor attract them from other states or abroad. So Idaho, Montana, Oregon, South Dakota, Washington are above the median in births and below it or at zero in the other three. Colorado and Nebraska can be put into this group.

TABLE 4

NUMBER OF AMERICAN MEN OF SCIENCE IN THE 48 STATES AND D. C. BORN IN FOREIGN COUNTRIES

Country	Number of American men of science in 48 states and D.C.	American men of science per million U.S.A. residents in 1930
England	280	346
Scotland	60	169
Wales	18	299
Ireland	21	23
Norway	52	149
Sweden	72	121
Denmark	47	262
Iceland	4	1,447
Netherlands	60	451
Belgium	20	312
Luxemburg	0	0
Switzerland	67	593
France	30	221
Germany	259	161
Poland	63	50
Czechoslovakia	32	65
Austria	98	264
Hungary	53	193
Yugoslavia	3	14
Russia	285	247
Latvia	15	726
Estonia	5	1,408
Lithuania	16	83
Finland	11	77
Rumania	18	123
Bulgaria	5	532
Turkey	14	286
Greece	15	86
Albania	0	0
Italy	22	12
Spain	5	84
Portugal	0	0
Danzig	1	674
Europe, not specified	2	135
Armenia	15	406
Palestine	3	489
Syria	10	175
China	29	629
Japan	26	366
India	34	5,812
Other Asia	21	1,998
Canada and Newfoundland	610	466
Cuba	3	162
Other West Indies	25	285
Mexico	16	25
Central America	5	476
South America	12	357
Africa	25	2,822
Australia	18	1,404
Azores and other Atlantic Islands	1	71
Pacific Islands	18	3,976
Puerto Rico, Hawaii, Philippines and Alaska	28	....

In general the states that produce do not retain, but Massachusetts, Ohio and Utah are notable exceptions. Attraction from other states and attraction from foreign countries show a surprising lack of correlation. Connecticut, Massachusetts and New York are very high in the former but at or below the median in the latter. Retention and attraction are also much less closely related than would be expected.

The correlation coefficients witness to the generally confused pattern of the states.[4] They are as follows, all deviations being taken from the medians:

	Pearson coefficient	Sheppard coefficient	Average
Birth with retention	−.14	−.38	−.26
Birth with attraction from other states	.09	.20	.15
Birth with attraction from abroad	−.44	−.58	−.51
Retention with attraction from other states	.28	.43	.36
Retention with attraction from abroad	.21	.18	.20
Attraction from other states with attraction from abroad	.30	−.30	.00

TABLE 5

PERSONS IN "AMERICAN MEN OF SCIENCE" BORN IN THE 48 STATES OR D. C. REPORTED AS RESIDING IN ALASKA, HAWAII, ETC.

Alaska	1
Territory of Hawaii	83
Philippines	13
Puerto Rico	21
Virgin Islands	1
England	10
Scotland	1
Norway	1
Denmark	1
Belgium	1
Switzerland	2
France	10
Germany	5
Austria	1
Hungary	1
Yugoslavia	1
Russia	1
Rumania	1
Turkey	2
Italy	2
Syria	10
China	27
Japan	1
India	9
Other Asia	4
Canada and Newfoundland	106
Cuba	2
Mexico	8
Central America	12
South America	16
Africa	10
Atlantic Islands	1
Pacific Islands	5

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[4] They would be disturbed in any case by the skewness

Table 4 presents, for American men of science residing in the 48 states and the District of Columbia, the number born in each of various foreign countries and the proportion which this number is of the total number of persons born in that country and residing (in 1930) in the United States. These proportions (each of which is the number of American men of science from the country in question × 1,000,000 divided by the total number of U. S. A. residents in 1930 from that country) are not measures of the contributions of the nations listed, because of differences in the times at which the immigrations occurred, in the proportions which the children of Americans temporarily abroad (as missionaries, government employees, etc.) are of the numbers born in the countries in question, and in other respects. But they are instructive if used with wisdom and caution.

The men of science born in the 48 states and the District of Columbia who were reported as residing in Alaska, the Territory of Hawaii, the Philippines, Puerto Rico, the Virgin Islands and in foreign countries are enumerated in Table 5; but I am unable to estimate how many in any of the groups are permanently residents outside of the states.

The Cattell list includes 901 men of science residing in Canada. Of these 577 were born in Canada; 106 in the 48 states and D. C.; 110 in England; 30 in Scotland; 4 in Wales; 46 in other European countries.

OBITUARY

JOHN GERALD FITZGERALD

ON June 20, Dr. John Gerald FitzGerald, director of the Connaught Laboratories and of the School of Hygiene, University of Toronto, died in his fifty-eighth year. Dr. FitzGerald was internationally known as an authority on medical education, as a leader in preventive medicine, as a scientific investigator and as a director of medical research. As a result of his vision, initiative and leadership, there were established in the University of Toronto the Connaught Laboratories and the School of Hygiene. Returning to his alma mater in 1913 as associate professor of hygiene and preventive medicine, University of Toronto, he devoted himself to an endeavor to create, within this university, a non-commercial scientific institute to fulfil two functions in the interests of medical public-service, *viz.*, research in the field of preventive medicine, and the preparation of diphtheria antitoxin and certain other biological products so that these products might be supplied throughout Canada in such a fashion as would ensure their being of high quality and low price. His insistent perseverance soon yielded success in this endeavor, and the antitoxin laboratory which he established at that time, and which shortly became known as the Connaught Laboratories, later proved to be a major contributing factor in the establishment of a national School of Hygiene at the University of Toronto. The achievements of these two institutes, the Connaught Laboratories and the School of Hygiene, are due in no small measure to Dr. FitzGerald's constant encouragement and promotion of intimate relationships and integration among teaching, research and public-service activities.

Serving as a member of the International Health Board of the Rockefeller Foundation from 1923 to 1931, subsequently as a scientific director of the foundation's International Health Division, and as a member of the Health Committee of the League of Nations from 1930 to 1936, Dr. FitzGerald evidenced his keen interest in international public health. In 1933–34, he joined General F. F. Russell and Dr. W. W. Jameson in making, for the International Health Division of the Rockefeller Foundation, a survey of health conditions in India, Ceylon and Egypt. In 1936–37, at the instance of the Division of Medical Sciences of the Rockefeller Foundation and in company with Dr. C. E. Smith, he undertook a survey of the teaching of preventive medicine to medical undergraduates in Europe and North America. For four years, 1932–36, he served as dean of the Faculty of Medicine, University of Toronto.

He gave generously of his time to various important administrative and research undertakings in Canada—the Dominion Council of Health, of which he was one of the original members, the National Research Council of Canada, the Ontario Research Foundation and the Banting Research Foundation—and to various professional societies, including the Canadian Medical Association, the Canadian National Committee for Mental Hygiene and the Canadian Public Health Association. He was elected a fellow of the Royal Society of Canada in 1920 and was honored by Queen's University with the degree of LL.D. in 1925. He was one of the charter fellows of the Royal College of Physicians and Surgeons of Canada.

He made many contributions to scientific literature. To meet the needs of medical students he early published a "Laboratory Guide in Bacteriology," and later "An Introduction to the Practice of Preventive Medicine," an extensively used text-book.

Within and far beyond the institutes to which John Gerald FitzGerald devoted his life, his work will continue to live, and he will be remembered as one who

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of the distributions, but if there were close resemblances in production, retention and attraction, the skewness would not reduce the coefficients greatly.

contributed richly to the advancement of public health throughout the world.

R. D. DEFRIES

RECENT DEATHS AND MEMORIALS

DR. STUART PRITCHARD, for the last ten years president and general director of the W. K. Kellogg Foundation at Battle Creek, Mich., an authority on tuberculosis, died on August 3 at the age of fifty-eight years.

DR. FRITZ SCHIFF, of the Beth Israel Hospital, New York City, died on July 30 at the age of fifty-one years. A correspondent writes: "Dr. Schiff, who was one of the outstanding bacteriologists in Europe, came to this country in 1936 and was appointed bacteriologist at the Beth Israel Hospital, New York City. He made important contributions to the subjects of the blood groups and the Salmonella group of organisms."

THE death is announced of Dr. Giuseppe Sanarelli, professor emeritus and formerly dean of hygiene and director of the Hygienic Institute of the University of Rome.

ACCORDING to the *Journal* of the American Medical Association, the old autopsy house of the Philadelphia General Hospital, where Dr. William Osler worked from 1885 to 1889, has been restored to be used as a museum of Osleriana. At the dedication in June eleven resident physicians who served with and under Dr. Osler were present, as was Dr. Howard A. Kelly, of Baltimore, the only living member of the group that served with Osler at the Johns Hopkins University. Dr. Joseph McFarland, who was resident physician at the hospital, then known as Blockley, in 1889, spoke on "Osler as I Knew Him," and Dr. William G. MacCallum, Baxley professor of pathology at the School of Medicine of the Johns Hopkins University, a former pupil, spoke on "Osler at Blockley." Other speakers were Dr. William E. Hughes, physician at the hospital from 1889 to 1914, now honorary consultant, and Dr. William E. Robertson, who paid tribute to Dr. David Riesman, one of those most active in the establishment of the memorial. Dr. Riesman died a week before the dedication. A painting of "Osler and Old Blockley," by Dean Cornwell, was unveiled.

SCIENTIFIC EVENTS

DISPERSAL OF SCHOOLS OF THE UNIVERSITY OF LONDON

THE report issued by the principal of the University of London for 1939–40 describes the dispersal of the schools of the university to Wales, Oxford, Cambridge, Bristol, Leeds and the Scottish universities. In an abstract published in the London *Times*, it is said:

> The dispersal had been planned early in 1939, but it was complicated by the government's unexpected decision not to call up men under the age of 20, which resulted in some 80 per cent. of the normal complement of male students requiring accommodation, instead of 25 per cent. Thanks largely to the cooperation of other universities, the difficulties of dispersal were successfully overcome, but war conditions have inevitably thrown much additional work on the staff and officers. Examinations have been held, and there has been no lowering of the university standard. The only schools to return to London have been those of medicine, for the sake of their clinical centers.
>
> The university is faced with the double prospect of diminished revenues and increasing expenses. The London County Council has reduced its grant by £8,600 for the year 1939–40; but almost all other grants from public bodies have been maintained. Private benefactions have been remarkably generous in the present circumstances; even the support granted by the Polish Government to the chair of Polish literature and history is being maintained. In spite of the withdrawal of a grant promised by the National Fitness Council towards the building of a new Students' Union, Lord Nuffield has decided to let his own grant for the same purpose stand.
>
> The Ministry of Information has occupied the Senate House, but has left the senate room and libraries to the university. The building of the Great Hall, the School of Oriental Studies and Birkbeck College is proceeding.
>
> There are 10,964 internal students reading for degrees and diplomas, as compared with 14,415 in 1939. An unexpected number of external students have enrolled, and, although extra-mural work has been drastically curtailed, extensive arrangements have been made for courses of instruction for troops, both in large camps and the smaller units.
>
> University College and King's College have agreed, in view of the recent occupation by the government of the buildings of University College, that both colleges alike should continue to carry on their work in the universities and colleges to which they have been dispersed.

EXPEDITIONS OF THE AMERICAN MUSEUM OF NATURAL HISTORY

DR. WALTER GRANGER, curator of paleontology of the American Museum of Natural History, is continuing his more than forty years of exploration for fossil mammals with an expedition into the Big Badlands of western South Dakota this summer. He left New York on July 25 for the headquarters of the expedition in Rapid City, S. D., to join Albert Thomson, preparator in paleontology, and Junius Bird, assistant in anthropology. The main objective of the expedition is to collect specimens of the small, three-toed horse, *Mesohippus*, a rhinoceros that was smaller than any of the species now living in Africa and Asia; various kinds of cats, especially the sabre-toothed tiger; and the remains of ***Entelodon***, whose nearest living relative is the pig. In deposits of far more recent times, above these fossil beds, have been found interesting evidences that ancient Indians once occupied this same region. Mr. Bird will carry on excavations in an effort to discover more about their culture. Chalcedony tools, such as scrapers and knives, have already been found, as well as pieces of black pottery. The expedition will be in the field until November 1.

Dr. Barnum Brown, curator of fossil reptiles, left New York on August 3 to lead the American Museum-Sinclair Expedition of 1940 into the Big Bend region of southern Texas, near Marathon. The expedition will excavate remains of the largest dinosaurs yet found. These bones were discovered last summer by Dr. Erich Schlaikjer, during a reconnaissance expedition for the museum. Dr. Schlaikjer and Roland T. Bird, preparator in paleontology, will join Dr. Brown in Marathon to assist in digging the bones out of the rock and preparing them for shipment.

Dr. Grace Fisher Ramsey, associate curator of the department of education, left New York on August 8, to conduct a study of the lives and work of Indian artist craftsmen in Mexico. She will also make color motion pictures of life in Mexican villages and collect materials which can be circulated from the department of education among schools and other institutions. These collections will be representative of the native crafts of the Mexicans of central, southwestern and southeastern Mexico and will include types of weaving in wool, cotton and various plant fibers; embroidery, drawnwork and beading; pottery to show regional designs; all types of metal crafts in silver, copper and tin; leather and lacquer work; masks, musical instruments and toys. Dr. Ramsey will be accompanied on the journey by Herman Sievers, staff assistant in education, Mrs. Sievers and Miss Ethel Fisher. Almost the entire trip will be made by automobile. The expedition will return to New York in the latter part of September.

Theodore A. McGraw, of Grosse Pointe, Mich., will lead an expedition in the Wrangel Mountains of Alaska. He will be accompanied by T. Donald Carter, assistant curator of mammals, who left New York on August 1. The purpose of the trip is to make a general collection of the mammals in this region, ranging from mice to grizzly bears, for the study collections. Work will continue until the first snowfall, and Mr. McGraw and Mr. Carter expect to return by the first part of October.

Dr. John E. Hill, assistant curator of mammalogy, is now making collections of small mammals in the southern part of Kansas. This work is of interest to the museum as part of its survey of animal life in the dust-bowl section; to determine what animals have been exterminated or driven out by drought and changing vegetation and those animals still remaining, which have survived these changes. Mrs. Hill and Peter Crow, of Cornell University, are assisting Dr. Hill. The expedition will be in the field until the middle of September.

THE NEW YORK ZOOLOGICAL SOCIETY

AT a special meeting on June 25 of the Board of Trustees of the New York Zoological Society, Fairfield Osborn was elected president to succeed W. Redmond Cross, who resigned in June. Mr. Cross had been president of the garden and chairman of the executive committee since 1937. Laurance S. Rockefeller was elected chairman of the executive committee, Mr. Cross remaining as chairman of the Board of Trustees. Mr. Rockefeller was also elected second vice-president of the board. The position of secretary, left vacant by Mr. Osborn's election to the presidency, will be filled later.

In a statement made by Mr. Osborn he said in part:

> The institutions operated by this society are visited annually by an immense public, equivalent numerically—not allowing for repeat visitors—to approximately four per cent. of the total population of the entire nation. This fact is more than a call for continuance as we are now; it is a direct challenge to us constantly to broaden and vitalize our contacts with the public. These contacts call for creation of advanced methods of exhibiting our unrivaled living collections, for highly efficient park and building administration, for advancing our education and conservation activities, and, back of the scenes, for pressing forward with research work in the laboratories at the Zoological Park and the Aquarium, this work, in many of its phases, contributing directly to the solution of human disease problems.

In regard to the activities of the society, it is announced that a contract has been let for construction of the African Plains exhibit in the Zoological Park—work on which was started on July 22. This development has been made possible by a member of the society who wishes to remain anonymous. Plans have been drawn for a new aquarium; important new exhibition units are in plan or at the point of construction for the aquarium in its present building, and the program of research, including phases of it bearing on human health problems, is now more active than at any time since the society was formed.

Some time ago the Rockefeller Foundation made a grant to the Zoological Society for the study of methods of production of films on zoology and allied subjects. It is hoped that this study will lead to the actual production of films. One script, on the life cycle of the eel, has already been prepared; three others are in preparation, on bird migration, the continental distribution of animals, and adaptation of form to movement.

With the advantage of its background, its great collection of wild animals, its scientific staff, its laboratories and its technical publication, the trustees plan to expand the scientific work of the society.

The retirement of Dr. W. Reid Blair as director of the Zoological Park on May 1 left a vacancy which was filled temporarily, at a meeting of the Board of Trustees on July 15, by the appointment of H. R. Mitchell as acting director. As already announced in SCIENCE, Allyn R. Jennings, general superintendent of the Park Department, was appointed general director of the Zoological Park and the Aquarium, and Harry Sweeny, Jr., director of parks in Queens and Manhattan, was appointed assistant general director.

Under the new form of management, Mr. Jennings will have general charge of operations both at the Zoological Park and the Aquarium. Dr. Charles M. Breder, Jr., continues as director of the aquarium but will be freed to a considerable degree of administrative duties, giving him more time to spend on scientific work.

SYMPOSIUM ON NEW TEXTILES OF THE AMERICAN CHEMICAL SOCIETY

A SYMPOSIUM on "New Textile Fibers, Fabrics and Finishes" will be held in connection with the hundredth meeting of the American Chemical Society in Detroit, September 9 to 13. Dr. Gustavus J. Esselen, president of Gustavus J. Esselen, Inc., Boston, has been appointed chairman of the symposium, sponsored by the Division of Industrial and Engineering Chemistry. Ten authorities in the field will deliver addresses.

Kenneth H. Barnard, of the Pacific Mills Print Works, Lawrence, Mass., will describe recent progress in textiles in New England. Pointing out that chemistry was largely responsible for taking the textile industry out of New England and transplanting it in the South, he will report how research, new uses, faster colors and modern finishes for textiles are overcoming the economic handicaps of the Northeastern region.

Robert Boyer, of the Ford Motor Company, will discuss "The Experimental Production of Fibers from Soybean Proteins." Dr. F. Bonnet, director of textile research and the standards laboratory of the American Viscose Corporation, will describe "vinyon," a copolymerized vinyl resin made of vinyl chloride and vinyl acetate. Vinyon yarn, largely utilized in industrial filter cloth, will invite many other uses because of its remarkable properties, including resistance to strong acids and alkalis at ordinary temperatures. It is asserted to be practically water-repellant and as strong when wet as when dry.

Dr. G. P. Hoff, director of nylon research of E. I. du Pont de Nemours and Company, will speak on "Nylon as a Textile Fiber." Dr. Games Slayter, of the Owens-Corning Fiberglas Corporation, will outline in what ways fiberglas, a new basic raw material, is being employed.

Dr. D. H. Powers, of the Röhm and Haas Company, Philadelphia, will show how synthetic resins for textile fabric modification improve the tensile strength, resilience, durability, luster and firmness of the fabrics without altering surface appearance, imparting to vegetable fibers many of the properties of animal fibers.

The forms, properties and uses of the cellulose acetate rayons will be the topic of Dr. Harold DeWitt Smith, of A. M. Tenney Associates, New York. Acetate rayons, according to Dr. Smith, account for approximately 30 per cent. of the total rayon production.

F. C. Atwood, of Atlantic Research Associates, Newtonville, Mass., will read a paper on "Protein Fibers." Electrocoated pile fabrics will be described by N. E. Oglesby and L. E. Hoogstoel, of the Behr-Manning Corporation, Troy, N. Y. To date, two types—dress goods and all-over covered pile material for upholstery—of textile products employing the electrostatic process are being manufactured commercially. The distinctive feature of a pile fabric manufactured by the electrostatic process is the density of pile attainable. This density is reflected in the wearing properties of the product.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

BEGINNING in September, each of the seventy-one local sections of the American Society of Mechanical Engineers in the principal industrial areas of the nation will sponsor several local meetings on the engineering problems of national defense and invite those present to make recommendations for their solution.

The parent society is planning a series of national regional meetings which will bring together the outstanding engineers and manufacturing executives of the country to discuss the engineering phases of the various elements of defense. It has announced the following dates and places for these meetings:

September 3 to 6, 1940—Fall meeting, Hotel Davenport, Spokane.

November 7 to 9, 1940—Joint American Society of Mechanical Engineers-American Institute of Mechanical Engineers meeting on fuels, Hotel Tutwiler, Birmingham.

December 2 to 5, 1940—Sixty-first annual meeting, Hotel Astor, New York.

April 1 to 3, 1941—Spring meeting, Atlanta.

June 16 to 20, 1941—Semi-annual meeting, Kansas City.

October 12 to 15, 1941—Fall meeting, Louisville.

The Inland Empire Section of the society has extended an invitation to mechanical, civil, electrical and mining engineers to attend the autumn meeting at Spokane.

Twenty-eight papers are announced for presentation at thirteen simultaneous technical sessions to be held on Tuesday, September 3, and Thursday, September 5. Twelve of these papers will cover the design, construction, mechanical equipment and potential uses of the Grand Coulee Dam, the world's largest masonry structure. Other subjects to be discussed include hydraulic problems, deep-well pumps, woodworking, coal, kiln drying, wood-waste utilization and material handling in the lumber industry.

Two luncheons, one dinner and a banquet are part of the program. At the luncheon on Tuesday, L. V. Murrow, Washington Toll Bridge Authority, speaks on the "Lake Washington Pontoon Bridge." At the dinner on Tuesday, Major S. E. Hutton and F. A. Banks discuss the "Columbia Basin Reclamation Project." Following the luncheon on Thursday, Sid Jenkins will describe "One Hundred Years of Logging in the White Pine Forests of Idaho." The speaker at the banquet on Thursday evening will be R. L. Neuberger, author of "Our Promised Land." Trips on Wednesday and Friday will be made to the Grand Coulee Dam, a lumber mill in Lewiston, Idaho, the Coeur d'Alene mining district and local plants of interest.

SCIENTIFIC NOTES AND NEWS

In recognition of "distinguished contributions to the science of genetics" two honorary degrees were conferred at commencement on Dr. George H. Shull, professor of botany and genetics at Princeton University. He received the degree of doctor of science from Lawrence College and the degree of doctor of laws from Antioch College, from which he graduated in 1901.

Honorary fellowship of the Royal Society of Medicine, London, has been conferred upon Dr. Mervyn H. Gordon, Sir Leonard Rogers, C. H. Usher, Dr. Louis Martin, Paris; Professor Felix Nager, Zurich; Professor G. Roussy, Paris, and Dr. Ralph Pemberton, professor of medicine in the Graduate School of Medicine of the University of Pennsylvania.

Dr. Frank H. Bethell, of the University of Michigan, has received one of the two annual Henry Russel awards for his "direction of field studies of anemias of pregnancy in Hillsdale County" in cooperation with the W. K. Kellogg Foundation.

The Heberden Society has awarded the Heberden Medal for 1939 to Major W. S. C. Copeman for his paper entitled "Notes on Treatment of the Rheumatic Diseases in the British Expeditionary Forces."

Dr. George W. Crile, emeritus professor of clinical surgery at the Medical School of Western Reserve University, has been made an honorary member of the Academy of Medicine at Cleveland.

At the time of the annual meeting of the American Surgical Association at St. Louis, there was founded a new organization, designed particularly for the closer association of the younger surgeons of the Middle West and adjacent Canadian provinces. This is to be known as the Central Surgical Association. The officers elected at the organization meeting were: *President,* Dr. Roy D. McClure, of Detroit; *President-elect,* Dr. Grover C. Penberthy, of Detroit; *Secretary,* Dr. George M. Curtis, of Columbus; *Treasurer,* Dr. Max Zinninger, of Cincinnati; *Recorder,* Dr. Henry K. Ransom, of Ann Arbor, and *Councillors,* Drs. Willis D. Gatch, of Indianapolis; Kellogg Speed, of Chicago, and Carl H. Lenhart, of Cleveland. The organization was further developed during the annual meeting of the American Medical Association in New York City. Its first regular meeting is to be held during the latter part of February next at the university hospital at Ann Arbor, Mich.

Professor H. H. Newman, for twenty-nine years a member of the department of zoology of the University of Chicago, will become professor emeritus on October 1.

Dr. Roger B. Corbett, dean and director of the College of Agriculture of the University of Connecticut, has been named director of the Agricultural Experiment Station of the University of Maryland to succeed Professor J. E. Metzger, who died last winter.

Dr. Charlotte Haywood, associate professor of physiology at Mount Holyoke College, has been appointed chairman of the department of physiology, succeeding Dr. Abby Turner, who has retired.

Dr. Martin Schwarzschild, of the Harvard College Observatory, has been appointed lecturer in astronomy at Columbia University.

J. C. Crocker, senior lecturer, has been appointed head of the department of chemistry of the Chelsea Polytechnic, London, to succeed C. Dorée, who, after serving for sixteen years, will retire on August 31.

Three of the five members of the faculty of Adelphi College, Garden City, Long Island, who were dismissed last spring, are bringing damage suits of $20,000 each against the college administration. It is stated by the authorities of the college that a general reorganization was made necessary at that time by a financial crisis in the institution. Those bringing suit are: William A. Colwell, head of the department of German for twenty-six years; Dr. Donna Fay Thompson, head of the department of sociology, who had been on the staff for sixteen years, and Dr. Edna Mosher, professor of biology since 1923, who had been head of the department for fifteen years.

THE newly elected president of the Chicago Museum of Science and Industry, Lenox R. Lohr, has made drastic changes in the staff, effective on August 15, by dropping heads of departments, some of whom had been with the museum ten years or longer. They are: Trent E. Sanford, architecture and civil engineering; C. Robert Moulton, chemistry; F. C. Brown, physics; J. A. Folse, power; R. B. May, transportation; Mary B. Day, library; Eric Fenger, staff engineer; E. C. Rauschenberg, superintendent of shops, and J. A. Maloney, public relations.

DR. BRUNO GEBHARD, formerly curator of the Museum of Hygiene in Dresden, has been appointed director of the Cleveland Museum of Health and Hygiene, which will open in October. Since 1937 Dr. Gebhard has been serving as technical consultant for the medicine and public health exhibits at the World's Fair in New York. Plans for the Cleveland Museum were initiated in 1939 when Mrs. Francis F. Prentiss gave the building and the Cleveland Academy of Medicine carried out a campaign for supporting memberships. In addition to exhibits for education in public health, the museum expects to have workshops for the creation of visual health aids for schools, colleges and other educational agencies.

DR. BERNARD WITLIN has resigned his positions as instructor of bacteriology at the Philadelphia College of Pharmacy and Science and as research bacteriologist at the Mulford Biological Laboratories of Sharp and Dohme, Inc., to become a member of the newly organized Barlin Laboratories at Philadelphia, Pa.

DR. R. RUGGLES GATES, professor of botany at the University of London, arrived in the United States on July 29. He is on leave of absence without salary for the duration of the war. Dr. Gates is working at the Marine Biological Laboratory at Woods Hole before going to Canada, where his address will be Middleton, Nova Scotia. He expects to be available for lectures during the coming academic year.

DR. EARL H. MYERS, who for the past two years has been working on a John Simon Guggenheim Foundation fellowship, has been awarded the Rhumphius fellowship from the Treub Laboratories of the Dutch East Indies. This fellowship has been granted to continue investigation of the life cycles and ecological relationships of the Foraminifera. Dr. Myers plans to return to America in December.

DR. L. G. M. BAAS-BECKING, formerly of Stanford University and now director of the 's Lands Plantentium te Buitenzorg, was called back to Holland in March, and was there when the low countries were invaded. A telegram has been received stating that he is alive and well.

THE National Research Council Committee on Human Heredity has at its disposal certain funds for use in furthering studies in human inheritance. Qualified persons are invited to submit requests for grants where needed to initiate or to continue research in this field. Requests should be sent as soon as possible to any member of the committee, and should include a clear statement of the problem, results already achieved, if any, the approximate time required to finish the problem, the amount of money needed and a statement as to how the money will be spent if granted. The committee consists of Halbert L. Dunn, Bureau of the Census, Washington, D. C.; L. C. Dunn, department of zoology, Columbia University; K. S. Lashley, department of psychology, Harvard University; George L. Streeter, bureau of embryology, Carnegie Institution of Washington, Baltimore, Maryland; Sewall Wright, department of zoology, University of Chicago, and Laurence H. Snyder, *chairman,* department of zoology, the Ohio State University.

THE second International Congress of Pure and Applied Science, which it was planned to hold at Columbia University in September, has been postponed. As soon as possible new arrangements will be made for the meeting.

DR. O. A. DRUMMOND, plant pathologist of the School of Higher Agriculture at Estado do Minas Gerais, Vicosa, Brazil, writes to the secretary of the American Association for the Advancement of Science that students or investigators from the United States, who may care to spend some time in that region, will be welcomed at the school.

THE University of Berne, Switzerland, has announced its annual prize for work on encephalitis lethargica which "signifies real progress in the diagnosis or treatment of the disease." Applications should be sent to the dean of the Medical Faculty.

FOR the academic year 1940–41, the Abbott Laboratories have established fellowships in several universities. The fellowships, carrying stipends of $650 per year, will be available to graduate students in the last or next to last years of graduate work leading to the doctorate degree. The recipients, who are to be selected by the universities in which their work is being done, are not limited as to the subjects on which they will work. Grants will be made in organic chemistry at Cornell, Harvard, Illinois, Michigan and Northwestern Universities; in biochemistry at California, Columbia and Cornell Universities.

ACCORDING to *The Collecting Net,* the number of investigators in each academic rank registered this summer at the Marine Biological Laboratory at Woods Hole, Mass., is: Professors, 63; associate professors, 19; assistant professors, 60; instructors, 46; research associates, 10; assistants, 71; fellows, 22; graduate students (not listed elsewhere), 27; medical students, 8; undergraduate students, 7; preparatory students, 3; miscellaneous, 22. The four institutions leading in providing investigators for the laboratory are: Pennsylvania, 34; Columbia, 20; New York University, 16, and Chicago, 11.

FOSSIL camels from South Dakota have been collected by an expedition of the Field Museum of Natural History. The camels lived in that state during the Miocene age, about 18,000,000 years ago. They form part of a collection which gives promise of being one of the best representations of fossil animals from the Rosebud Beds in South Dakota, according to Paul O. McGrew, of the paleontological staff, who is the leader of the expedition. Other specimens include a large number of skeletons and skulls of the extinct ungulates known as oreodonts, extinct peccaries and horses. Also included is an especially fine representation of extinct species of rodents, some of which are believed to be of kinds hitherto unknown to science. Nearly all the material obtained represents mammals not previously represented in the collections of the museum.

Nature states that the British Minister of Labor and National Service has made an order for the compulsory registration of professional engineers. It refers to those who are normally engaged in a technical or supervisory capacity in aeronautical, automobile, chemical, civil, structural and municipal, electrical, gas, locomotive or mechanical engineering; and those normally engaged on research work in the engineering sciences at a university or in research and development work in any industry or as a teacher of engineering science. Men whose names are already on the Central Register are not to register again. There are 22,000 names in the engineering categories of the register, of whom about 800 are not in employment, and it is estimated that 30,000 more names will be added.

THE London *Times* announces that Lord Perry, chairman of the Ford Motor Company, with the approval of the British Ministry of Agriculture, the Henry Ford Institute of Agricultural Engineering, at Boreham, near Chelmsford, is offering 40 free scholarships for the training of British boys for careers in agriculture. The scholarships comprise 10 that are tenable for three years, 10 for two years and 20 for one year. Each is valued approximately at £175 a year, which includes cost of tuition; board and residence during terms at Boreham House, near the Fordson estates; laundry; pocket money during terms and holidays; special clothing and boots. The cost, estimated at £7,000 a year, is to be defrayed by Henry Ford. The intention is to provide theoretical and practical instruction in the latest methods of every branch of farming, with classroom tuition and field work in alternate months, in order to train the boys to become key men in British agriculture. The estates attached to the institute cover 4,000 acres, and are devoted to corn crops, intensive market gardening, glasshouse culture, a fruit section with gas storage and the care of 2,000 pigs, 700 sheep and 200 dairy cattle. Applicants for scholarships will be required to attend the institute for a probationary period of one month, during which the final selections will be made of the prospective recipients.

DISCUSSION

INSECT CULTURES INBRED FOR 200 GENERATIONS

IN our insect-rearing laboratory at the Ohio State University we now have cultures of the blowflies *Lucilia sericata* and *Phormia regina* which have been inbred for ten years or approximately 200 generations. These cultures have lost nothing in vigor and are well adapted to laboratory rearing and uses.

In 1930 the Division of Insects Affecting Man and Animals of the U. S. Bureau of Entomology decided to make a study of blowfly maggots which were useful in the treatment of certain types of infections, especially osteomyelitis. In June of that year I was invited to Washington, D. C., to begin the first steps of this work. Cultures of blowflies were being maintained at that time at the Naval Hospital in Washington and at Children's Hospital School in Baltimore, where the treatment had originated under Dr. Wm. S. Baer. These cultures consisted of a mixture of species of flesh flies obtained by placing bait out of doors and collecting eggs. Consequently, one of the first necessary steps was to establish pure cultures of known species of flies.

At that time cultures of three species were started. One was the species *Calliphora erythrocephala,* which was later discarded because it was found to be less satisfactory for clinical use. The other two species were *Lucilia sericata* and *Phormia regina*. The Lucilias were started by the capture of a single female fly which deposited a small cluster of eggs, thus producing the first cage of stock. These related individuals were then inbred to continue the culture. The Phormias were established three months later. From this original stock, material was transferred to our laboratory at the Ohio State University in October, 1930, and have been maintained by inbreeding continuously ever since.

Among the early problems that had to be settled were those of food and rearing, such as failure to pupate and the loss of adult flies from bloating. After trying many foods such as fruits and fruit juices, honey and sugar solutions, and a wide variety of meats for both the adults and maggots, the following simple foods were chosen.[1] Adults were fed lean beef, which was essential to egg development in females, and brick sugar. Fresh tap water was supplied at all times. The maggots were fed fresh hamburger. No other food has been used over a period of eight years. The cultures have flourished and selective measures seem to have eliminated the rearing difficulties mentioned. The flies have been very useful for research on osteomyelitis, insect physiology, insecticide testing and as class material.

D. F. MILLER

THE OHIO STATE UNIVERSITY

SPONTANEOUS ACTIVITY OF THE SPINAL TADPOLES OF THE FROG AND THE TOAD

IN connection with our work on the development of swimming and righting reflexes in the tadpoles of the frog (*Rana guentheri*) and the toad (*Bufo bufo asiaticus*) and the effects thereon of the transection of the central nervous system at different levels about the time of hatching, we were surprised to find that spinal tadpoles show spontaneous activity. This is entirely contrary to what is observed in spinal frogs and toads, which hardly ever make any movement when not externally stimulated.

Decapitated tadpoles, tadpoles with only a small caudal fragment of the spinal cord intact, all move about without any noticeable external stimulation. These spontaneous movements come periodically—occurring every five to ten minutes, or every twenty to thirty minutes, or one to one and a half hours. The active period lasts from one second to one minute. Lack of suitable recording instruments prevented us from taking some accurate continuous records of this spontaneous motility from the time after operation to the time of the death of the animal.

Further destruction of the remaining spinal cord abolishes the spontaneous activity.

It is extremely difficult to rear these spinal specimens, and therefore it is not as yet possible to ascertain whether they still show spontaneous motility after metamorphosis.

This striking difference in the behavior of the tadpole and the adult form of the frog and the toad after the removal of the brain leads us to ask how it comes about. Might not the spinal centers of the adult have become so accustomed to take orders from the higher centers that they lose their own initiative?

GING-HSI WANG
TSE-WEI LU

INSTITUTE OF PSYCHOLOGY,
ACADEMIA SINICA,
KWEILIN, KWANGSI, CHINA

THE CASE HISTORY OF A SCIENTIFIC NEWS STORY

ON August 21, 1937, the United States National Museum published a bulletin written by me and entitled "The Fort Union of the Crazy Mountain Field, Montana, and Its Mammalian Faunas." Highly technical in character, this publication of 287 pages describes the geology and paleontology of Middle and Upper Paleocene strata in central Montana. As is their custom, the officials of that museum released to the press a non-technical résumé of this publication. The release was submitted to me for approval and was issued only after revision seemed to leave no possible false impression. It was a rigidly correct and yet easily comprehensible summary carefully avoiding any sensational claims or mis-statements. My own institution, the American Museum of Natural History, was mentioned in the story and its clipping service sent in versions of this story as it appeared in ninety-three different papers from Maine to California and from the Great Lakes to the Gulf of Mexico.

Six papers, from such cities as Worcester, Mass., and Butte, Montana, published the release almost exactly as it was written. Less than one fourth of this version refers to the oldest known primates, included in the faunas described in the bulletin. The bulletin and the original release emphasize that these are not in a direct line of modern primates or man, but that they are very ancient representatives of the same broad group of mammals. They also point out that it was not I who discovered these ancient primates. Even in the reprints of the whole release a few errors crept in, among them a statement that the fossils in question are 70,000,000 years old, a considerable exaggeration. The headlines were innocuous, although the Butte, Montana *Standard* spread across three columns "Montana's Crazy Mountains Listed as Cradle of Animal Life to Which Man Belongs," which escapes falsity largely by being nonsensical.

The sedate *New York Times* rewrote the story as a

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[1] James Godfrey Haub and David Franklin Miller, *Jour. Exp. Zool.*, 64: 52–55, November 5, 1932.

"special," and their version appeared without much change in twenty-nine newspapers. This was a skillful and generally accurate condensation of the original press release to about a third of its original length. The text of this dispatch carefully points out that the primates discussed are not ancestral to living primates or to man, and yet the *Times'* own headline was "Man 'Traced' Back 70,000,000 Years," and the other papers all followed suit, with even less restraint. This story, too, refers to 70,000,000 years, although in a later paragraph it gives the much lower figure that I really authorized. Writing a special article for the *Washington Star*, Mr. Thomas R. Henry was irked even by the larger figure and changed it to "seventy or eighty million years ago," presumably on his own authority.

The Associated Press used the release as basis for a rewritten and much modified dispatch that appeared in thirty-four papers. The tone of this is set by its first sentence: "Man, instead of having descended from the monkey, probably ascended from a four-inch long, tree-dwelling animal which was the ancient granddaddy of all mammals on earth to-day." It went on to suggest that I held that man might have originated in the western United States rather than in Asia. It may not be necessary to insist that I have never made and do not believe any such statements as these or others of less importance in the same dispatch. The headline writers outdid themselves on this version of the story:

> Monkey Father of Man? Nope, a Mouse.—Sacramento, Calif., *Union.*
>
> 4-inch Fossil Seen as Daddy of All Mammals.—Richmond, Va., *Times-Dispatch.*
>
> Four-Inch Tree Animal Seen as Man's Ancestor.—Shreveport, La., *Times.*
>
> Here's New Kind of Monkey Story.—Lynchburg, Va., *Advance.*
>
> Study of Mammals Brings about New Evolution Theory.—Newport News, Va., *Press.*
>
> Western U. S. Now Held to be Man's Birthplace.—Tacoma, Wash., *Ledger.*

The United Press dispatch, appearing in some cases with Mr. Hillier Krieghbaum's by-line, has been clipped from twelve papers. This story, happily for me, steered clear of the subject of man's ancestry and emphasized the survival of mammals after the dinosaurs became extinct. The story is well written, reasonably accurate, and interesting, so that it would be ungrateful to insist too much on the fact that it has very little to do with the particular research to which it refers. There is not much snappy headline material here, and the best, or worst, they could do was "Mice of 70,000,000 Years Ago Outlast the Dinosaurs." Incidentally, the recurrent theme of rats and mice in these various versions is the result of saying that some of these early mammals were as small as rats and mice. Of course they were not rats or mice, nor was such a statement made in the original release.

Mr. David Dietz, the Scripps-Howard science editor, made by far the best condensation and rewrite of the story, giving a good idea of the essential meaning of the work and a brief but fair summary of its results. Unfortunately, this account appeared in only two newspapers, as far as our clippings show. The New York *World-Telegram* headed the story chastely "Primeval Life in America." *Science Service,* quoted by four papers, also produced a reasonable account, although one slightly less accurate and much less enlightening than that by Mr. Dietz.

Only four papers seem to have written their own unsyndicated accounts. Apparently these were based without credit on the garbled Associated Press version, which of course they garbled still farther. Two of them, like several that used credited press services, have me discovering the missing link. A story in the Philadelphia *Record* contains just four sentences, not one of which is even roughly true, either as scientific statement or as the quotation from me that it purports to be. Unfortunately, they did spell my name correctly, so that it is clearly I who am represented as "clambering about man's family tree" whence I announce that a "tiny rat is latest ancestor of man."

This furore died down in October, 1937, and I sighed in relief and set about trying to live down the newspapers' ideas of what I had said. Then on April 18, 1938, the Gloversville, N. Y., *Leader* published an account of the Mohawk Valley Kennel Club's show in the course of which they gave me (under a wrong but all too recognizable name) as authority for the existence 70,000,000 years ago in Montana of dogs as large as Kodiak bears. Then another town had a dog show, and this time it appeared that I had not only discovered such dogs but had described sixty different species of them. This is appalling fertility of imagination, for the original release contained no mention whatever of the discovery of dogs, whether as large as Kodiak bears or as small as mice. Dog fanciers and newspaper exchanges being what they are, I subsequently enjoyed another period of fame, this time as the discoverer of the great, 70,000,000 year old Kodiak-bear-dogs, which no more existed and which are no more my invention than the rats ancestral to man. Years after the original press release, this truly ridiculous story is still occasionally appearing.

For some time I received letters from all over the country, all beginning in essence "I see by the papers where you say—" and then going on to vilify or, less commonly, to praise me for things that I never have said and never would say. These letters have little to do with the case, but they do show that people were interested and in many cases excited by the newspaper accounts. This is hopeful, because it suggests that even the truth might have interested them had the press seen fit to make it available.

Out of nearly one hundred papers whose stories finally came back to me, about one tenth had reports that were neither seriously wrong scientifically nor obnoxious to me personally. In view of the great need for popular presentation of the results of research, and in view of the mechanisms set up for this purpose and used in this case, this is a serious matter despite its humorous side. It is fairly typical of what still happens to scientific news, and it has a moral, in fact several of them, that will be obvious to the reader.

G. G. SIMPSON

THE AMERICAN MUSEUM OF NATURAL HISTORY

SOCIETIES AND MEETINGS

THE EASTERN SECTION OF THE SEISMOLOGICAL SOCIETY OF AMERICA

THE Eastern Section of the Seismological Society of America held its fifteenth annual meeting on May 31 and June 1, 1940, at Xavier University, Cincinnati, Ohio. The sessions were well attended, and all the prominent seismological observatories of the United States westward to the Mississippi Valley were represented; on account of the international situation, the Canadian seismologists did not attend. The members and guests of the section were welcomed by the Reverend Dennis Burns, S.J., president of Xavier University, and by the Reverend V. C. Stechschulte, S.J., director of the Xavier seismic station.

Professor Arthur C. Ruge, of the Massachusetts Institute of Technology, chairman of the section, presided at the four sessions during which the business of the section was transacted and the scientific papers were presented. Detailed reports were given on "Amateur Seismology" by J. J. Lynch, S.J., of Fordham University, and on "Methods and Operations" by E. L. Perry, of Williams College; these reports aroused much interest and discussion; it is hoped that they may be made available in printed form for distribution. The report of E. A. Hodgson, of the Dominion Observatory at Ottawa, on "Vault Construction" was read by title because of his enforced absence; however, the detailed report has since been mailed by the observatory to all seismic stations; it constitutes the most authoritative and up-to-date source of information that we have on the subject.

Twenty-two papers were presented on a variety of topics in theoretical and instrumental seismology. Captain N. H. Heck, of the U. S. Coast and Geodetic Survey, discussed recent developments in strong motion recording and showed excellent records of the Imperial Valley earthquake which had occurred a few days before the meeting; he gave interesting details of the effect of the European war on international scientific societies. Other papers of particular interest were: "Observations of Microseisms at Spring Hill College, Alabama," by A. J. Westland, S.J., and C. J. Elliot, S.J., of Spring Hill College; "The Earthquake Analyzer," by Arthur C. Ruge, of the Massachusetts Institute of Technology; and "A 'Synchronous Direct Current Motor' for Seismograph Recorders," by J. H. Nelson, of the U. S. Coast and Geodetic Survey. Two topics were discussed at length by the entire section; H. E. McComb, of the U. S. Coast and Geodetic Survey, led the discussion on "Instruments," and J. B. Macelwane, S.J., led that on "Seismic Prospecting." The leaders had prepared carefully questions and arguments on theoretical and practical aspects of seismology that provoked extended and at times heated debate.

The following officers were elected unanimously for next year: *Chairman,* A. J. Westland, S.J., Spring Hill College; *Vice-Chairman,* R. R. Bodle, U. S. Coast and Geodetic Survey; *Secretary,* W. A. Lynch, Fordham University; *Treasurer,* H. Landsberg, Pennsylvania State College; *Fifth Member of the Executive Committee,* A. C. Ruge, Massachusetts Institute of Technology. An important resolution was adopted requesting the Electric Utilities of the United States to aim at closer frequency control to assist observatories and other scientific bodies in making time measurements.

An excellent luncheon served on Saturday by Xavier University provided a fitting close to a thoroughly enjoyable and instructive meeting.

WILLIAM A. LYNCH,
Secretary

FORDHAM UNIVERSITY

THE BOTANICAL CONFERENCE AND FORAY AT THE ALLEGANY SCHOOL OF NATURAL HISTORY

A TOTAL of eighty naturalists participated in the botanical forays held at the Allegany School of Natural History over the week-end of June 21–23. The following societies were represented: Botanical Society of America, American Society of Plant Taxonomists, Torrey Botanical Club, Burroughs-Audubon Club of Rochester, Nature Sanctuary Society of Western New York, Western Pennsylvania Botanical Club and Sullivant Moss Society. The conference attracted botanists from a widely scattered area, including South Dakota, Wisconsin, Ohio, Tennessee, Pennsylvania, New York, New Jersey and Massachusetts.

The program started with a dinner at the school on Friday evening, followed by two illustrated lectures in the Assembly Hall. Dr. William N. Fenton, associate anthropologist of the Bureau of American Ethnology, Smithsonian Institution, Washington, D. C., spoke on the subject, "Ethnobotanical Remains among the Senecas." He discussed the use of native plants in primitive medicine, religious ceremonies and aboriginal industries. A. F. Hough, assistant silviculturist of the Allegheny Forest Experiment Station, Philadelphia, Pa., delivered the second lecture, "Research Projects in the Allegheny National Forests." Both talks were based on prolonged technical studies and were greatly appreciated by the audience of about fifty persons.

Saturday morning was devoted to a foray on Jones Hill, south of Steamburg, N. Y., about fifteen miles from the school. Steamburg lies in the terminal moraine of the last glaciation, and the upper slopes of Jones Hill were unglaciated. An unusual variety of vascular plants were found in this one locality. Splendid views of the surrounding country rewarded those who reached the top.

At noon the caravan followed New York State Route 17 along the picturesque Allegheny River Valley for nearly twenty-five miles to St. Bonaventure. Arrangements for luncheon had been made through the kind offices of Professor Hubert Vecchierello, head of the biology department at the college. The medieval atmosphere of the huge refectory and the tour of the splendid romanesque library will not soon be forgotten.

Later the party returned to Steamburg to visit a bog in the terminal moraine area. All five of the native coniferous trees, tamarack, black spruce, balsam fir, white pine and hemlock, were found. Of special interest was the discovery of *Arisaema stewardsoni* at Chamberlain's Bog by Dr. Norman C. Fassett.

After dinner at the Allegany School the evening of Saturday was spent informally with the library and laboratories of the school open to the guests so that finds of the day could be examined and discussed. Some enthusiasts worked until after midnight arranging their collections.

Short forays designed to accommodate special interest groups were held on Sunday morning. W. Burdett Moose, high-school principal of Coudersport, Pa., led the Fern Foray to South Mountain and Sheffield Hill. Dr. Robert B. Gordon, of the State Teachers College at West Chester, Pa., and L. K. Henry, of the Carnegie Museum at Pittsburgh, led another foray through the mature forest area known as Big Basin for the benefit of forest ecologists and mycologists. A general botanical foray to Bear Bog was led by Homer A. Jack, of Cornell University. Dr. R. H. Goodwin, of the University of Rochester, Dr. Norman C. Fassett, of the University of Wisconsin, and Dr. Earl E. Sherff, of the Chicago Teachers College and Field Museum, were among the able participants who assisted. A fourth foray was planned for the bryologists and lichenologists, with Olean Rock City as their destination. Dr. Margaret Fulford, of the University of Cincinnati, Dr. P. Boehner, of St. Bonaventure College, and Mr. and Mrs. Warren Bleckman, of Buffalo, N. Y., furnished leadership.

The conference closed on Sunday with a dinner at the Allegany School. Chauncey J. Hamlin, president of the Buffalo Society of Natural Sciences, made a presentation speech awarding the Pugsley Bronze Medal to William P. Alexander, curator of adult education at the Buffalo Museum, for his pioneer work in establishing the first nature trail in the Allegany State Park in the summer of 1921.

ROBERT B. GORDON,
Director

ALLEGANY SCHOOL OF NATURAL HISTORY

REPORTS

THE WILLIAM JOHN GIES AWARD, RESEARCH FELLOWSHIPS AND GRANTS-IN-AID OF THE AMERICAN COLLEGE OF DENTISTS

THE Committee on Dental Research take pleasure in reporting that the accomplishment of two primary objectives, the initial bestowal of the William John Gies Award and the assignment of the first research fellowships and grants-in-aid, has coincided appropriately with the centennial of organized dentistry.

In undertaking the necessary survey of the need and opportunity for promoting dental research, our greatest encouragement and reassurance lay in the fact that we could look to the International Association for Dental Research for guidance and support, relying upon the valuable experience gained by them in their continuous efforts towards the scientific solution of dental problems and the standards of quality and intelligence which have been set by their distinguished *Journal of Dental Research*. The association listened cordially to a preliminary outline of our plans and projects and lent to our deliberations the services of a cooperative committee, whose information, advice and support have been available at all points, and, needless to say, of inestimable service in the attainment of our objectives. We are indeed most grateful to these gentlemen. The value and significance of being in touch with minds striving toward the upbuilding of dental science, and the intrinsic worth of their assistance in setting up definite standards and regulations will be an enduring influence, we hope, in making the administration of our research funds an increasingly effective stimulus to professional and scientific growth.

In accordance with the policy of the college to give public recognition to one who in any field of science has made an outstanding contribution to the progress of dentistry, the Centennial Celebration in Baltimore was selected as a most fitting occasion for the initial William John Gies Award of the college. It was therefore bestowed, on March 17, 1940, upon Peter John Brekhus, of Minneapolis, for distinguished services in the cause of dental education and research in this country. The award, in the form of a suitably engrossed citation, was presented not only to glorify the recipient in the eyes of his fellow-workers, thus adding to the prestige of the quietly effective labors to which our research workers are faithfully devoting themselves, but also to acknowledge, as openly and strikingly as possible, the debt of all members of our profession to those who fulfil in highest measure the avowed function of us all—to enlarge the scope of dental science so far as experience, ability and opportunity will permit. It is the earnest hope of our committee that the simple ceremony at Baltimore may have impressed upon the public at large the fact that we—the whole body of our profession—are engaged upon an endless quest, to seek out the ultimate laws of health and discover more and more surely the principles which govern their application to human welfare.

Our research fellowships and grants-in-aid are intended as a practical expression of this same fundamental need in our professional life—a need not only of the results which research may produce, but also of the pervading influence of the spirit of research. We must live not only in the present, with its task and its reward; but with the zest of fresh discoveries and new insights which may lie just ahead—with the constant expectation that old difficulties will vanish as the forces of nature are better understood. Little by little we can gain upon the vast areas of the unknown; and to promote this conquest the research funds have been awarded, with our best wisdom and discrimination, after due study of the credentials and projects of the applicants by a subcommittee which had previously set up the necessary mechanism of appropriation, application, supervision and publication of results. The names of the successful applicants, with the sums awarded, the inquiries and where they are to be pursued are as follows:

Dr. Harrison R. Hunt and Dr. Carl A. Hoppert, $100.00, "Inheritance factor in resistance and susceptibility to dental caries in rats," Michigan State College.

Dr. Albert H. Kniesner, $500.00, "The factors in saliva which influence the growth of *L. acidophilus* and are indicative of the presence or absence of dental caries," School of Dentistry, Western Reserve University.

Dr. Sidney B. Finn, $1,200.00, "The effect of applications of sodium fluoride in preventing and controlling dental caries in children," School of Dentistry, University of Rochester.

Dr. Samuel Seltzer, $500.00, "The anti-bacterial action of drugs which have been recommended for cavity sterilization," Dental School, University of Pennsylvania.

Dr. M. L. Tainter, $400.00, "The general problems involved in the evaluation of the abrasiveness of dentifrices and their individual constituents," College of Physicians and Surgeons, San Francisco, Calif.

Dr. James Nuckolls, $500.00, "The primary centers of lobular development, growth and calcification in the tooth," Dental College, University of California.

Dr. B. Orban, $500.00, "Wound healing after different methods of gingivectomy and post-operative treatment," Dental School, Northwestern University.

William J. Furuta, $1,000.00, "Histologic study of the effect of various mineral deficiencies in dental and oral structures in animals," College of Dentistry, University of California.

A. L. Midgley,
Chairman

Committee on Dental Research of
the American College of Dentists

SPECIAL ARTICLES

THE VOLTAMMETRIC DETERMINATION OF OXYGEN

By the term "voltammetry" we mean the determination and interpretation of current-voltage curves obtained in electrolysis experiments using a suitable microelectrode as an indicator electrode. By indicator electrode we mean that the current is determined entirely by the phenomena occurring at that particular electrode, the potential of which may be varied by varying the e.m.f. applied across the electrolysis cell consisting of the indicator electrode and a depolarized reference electrode of practically constant potential. When using the dropping mercury electrode the terms "polarography" (self-registering apparatus) and "polarometry" (manual apparatus), introduced by Professor J. Heyrovsky in Prague, are synonymous with voltammetry.

Oxygen can be determined in a simple way with the dropping mercury electrode.[1,2,3] Our studies have

[1] V. Vitek, *Coll. Czech. Chem. Comm.*, 7: 537, 1935.

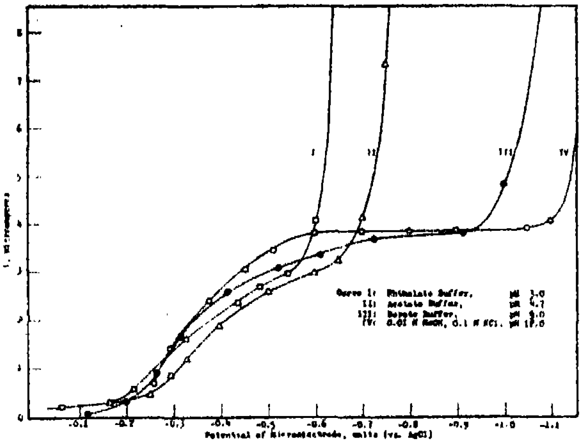

Fig. 1. Reduction of oxygen in various air-saturated solutions.

shown that oxygen can also be determined voltammetrically by using a platinum wire microelectrode. The electrode consisted of a platinum wire 4 mm long and 0.5 mm in diameter sealed on the end of a glass tube and suspended in the solution. A 0.1 N silver-silver chloride electrode was used as a reference electrode. Fig. 1 shows some current-voltage curves obtained at 25.00° C. in various air-saturated buffer solutions with pH values between 3 and 12. The diffusion current was found to be proportional to the oxygen concentration, but it changed markedly (about 4 per cent. per degree) with the temperature. From our results we calculated that the diffusion coefficient of oxygen is 2.38×10^{-5} cm^2 sec^{-1} at 25° C.

A disadvantage of the wire electrode is that at each value of the applied e.m.f. it is necessary to wait about two minutes until a steady state has been reached. From then on the current remains constant for relatively long periods of time. This constancy of the current is an advantage over the dropping mercury electrode, with which a fluctuating current is obtained. A disadvantage is that the hydrogen overvoltage on platinum is very small, so that in relatively weakly acid medium (pH less than 6) the discharge of hydrogen interferes with the determination of the diffusion current of oxygen.

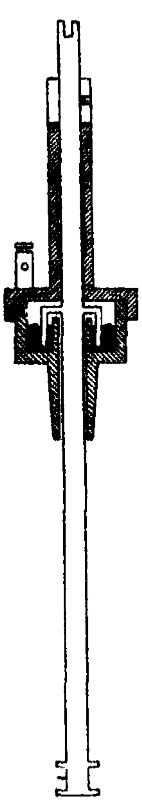

Fig. 2.

The disadvantage of waiting for a steady current state can be eliminated by working with a rotating electrode. The speed of rotation must be kept constant in order to get reproducible results. Fig. 2 shows a mercury-sealed electrode which was rotated at 600 R.P.M. by means of a synchronous motor. From a practical viewpoint the rotating electrode has the following advantages: (1) the current is immediately constant and (2) the measured currents are much larger than with the stationary electrode. For example, the diffusion current of oxygen in an air-saturated solution was 3.5 microamperes with the stationary electrode and about 60 microamperes with an electrode of the same size rotating at 600 R.P.M. Thus, the rotating electrode can be used for the determination of traces of oxygen.

Fig. 3 shows some current-voltage curves obtained with an air-saturated solution of 0.1 N potassium chloride, and the same solution after bubbling tank nitrogen through the solution for 10 minutes.

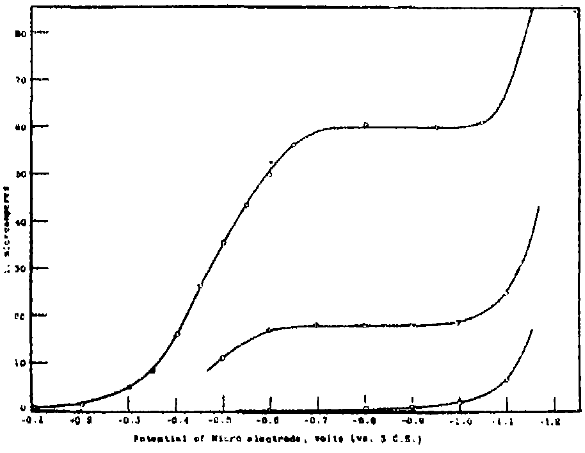

Fig. 3.

The rate of removal of dissolved oxygen by bubbling unpurified tank nitrogen through the solution at a rate of about 4 bubbles per second is shown by the data given in Table 1, which shows the diffusion current as a function of the time of bubbling nitrogen through the solution.

TABLE 1

Time of bubbling N_2, min.	0	5	10	15	20	30	40	60
i_d, microamperes …	61.0	31.7	18.0	8.87	3.65	1.40	0.94	0.79

A longer time of bubbling did not appreciably lower the diffusion current. Tank nitrogen from which oxygen was removed by passage through an electric heating tube containing copper turnings at a temperature of about 500° did not give an appreciably lower diffusion current, even after prolonged bubbling. It was shown that the trace of oxygen remaining in the solution diffused through the agar plug and sintered glass plate

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[2] H. G. Petering and F. Daniels, *Jour. Am. Chem. Soc.*, 60: 2796, 1938.

[3] C. S. Miller, Ph.D. Thesis, University of Minnesota, 1940.

separating the two halves of the electrolysis cell,[4] since the diffusion current of oxygen increased from 0.79 microampere to 1.10 microamperes when the solution was allowed to stand for 10 minutes with no nitrogen bubbling, but the electrode rotating. By using a large silver anode in a simple cylindrical electrolysis cell, it was possible to reduce the diffusion current of oxygen to 0.60 microampere using unpurified tank nitrogen and to 0.20 microampere using the purified nitrogen.

Assuming that the residual current in an entirely air-free solution was given by the current obtained in the sulfite experiment described below (0.15 microampere at 0.8 V vs. S.C.E.), the oxygen content of the unpurified tank nitrogen is calculated to be 0.15 per cent., and that of the purified nitrogen 0.02 per cent.

Heyrovsky[5] and Hohn[6] describe the use of sodium sulfite to remove dissolved oxygen, but give no quantitative data regarding its efficiency, or the rate of the reaction between oxygen and sulfite in neutral or alkaline medium. In the present study, 0.1 gm of sodium sulfite was added to 100 ml of 0.1 N potassium chloride, allowed to stand for 10 minutes, and a current voltage curve was determined with the rotating electrode. No trace of oxygen was detectable in the solution. The current-voltage curve is shown as the lowest curve in Fig. 3.

The stationary and the rotating wire microelectrodes are also useful for the voltammetric determination of other constituents which can be electro-reduced or electroöxidized. These applications and experimental details will be discussed in forthcoming papers.

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A DEFICIENCY DISEASE OF FOXES

A DIETARY disease that occurs in animal populations and is associated with the feeding of fish has been found in our investigations to be a vitamin deficiency and to be the counterpart of the alcoholic polioencephalitis of man described as Wernicke's disease. This condition, which we have for years termed "Chastek paralysis," is of considerable economic importance in the fox-raising industry. Clinically, it presents a well-defined syndrome characterized by a preliminary period of anorexia lasting a week or ten days, followed by a rapid development of weakness, ataxia and spastic paralysis. Death usually occurs within 48 to 72 hours after the onset of neurologic disturbances. Up to the present time we have observed outbreaks of this disease on fox ranches located in five different states. Most of them have occurred during the months from November to May, inclusive, and no large outbreaks have been noted during the summer. The mortality has varied from 1 to 37 per cent. of the total herd, according to the type of treatment instituted. Small ranches with as few as 17 pairs of foxes and large ranches having several thousand foxes have been affected.

The clinical characteristics of the disease have been essentially the same in all outbreaks. They have, without exception, occurred on ranches where fish or fish products were fed as 10 per cent., or more, of the diet. The first evidence of disease among the foxes usually appears from three to six weeks after fish have been added to the diet. The foxes show only anorexia for a week or 10 days and then a few animals at a time begin to exhibit signs of neurologic disturbances. These include weakness and unsteady gait, ataxia, hyperesthesia and spastic quadriplegia. Convulsions may occur shortly before the animal dies. The symptoms are always progressive and lead to death within a few days.

Repeated attempts to demonstrate an infectious agent as the cause of the disease have been consistently negative. A total of about 190 red foxes, 20 dogs, 7 ferrets, 6 mice, 6 squirrels and 12 rabbits and guinea pigs have been inoculated with suspected material by intraperitoneal, subcutaneous, intramuscular or intracranial routes or have been fed the material by stomach tube in attempts to transmit the disease. In no case has the disease been successfully transmitted.

Dietary experiments show that this disease can readily be produced by feeding foxes a ration poor in vitamin B_1 and containing fresh fish.

Carp has been the most common species of fish used on ranches where this disease has appeared. However, quillbacks, mullets and suckers, and Atlantic whiting have also been incriminated. The fish causing this disease have come from a variety of sources, including the Atlantic Ocean, fresh-water lakes in Utah, Minnesota and Canada, and the Cedar River in Iowa.

It is clear that the course of all the outbreaks has been determined by the dietary management on the ranch. In all cases the disease has been progressive, involving an increasing number of foxes as long as fish remained in the diet. In most instances the owner of the fox farm has suspected fish to be a cause of the disease and has eliminated it from the diet within a short time after the first death occurred. On one ranch, however, the feeding of fish was not discontinued until three weeks after the first death, and the result was a mortality of 34 per cent. in a herd of over 200 foxes.

After fish has been eliminated from the fox ration, the outbreaks have subsided either rapidly or very gradually, depending upon other dietary factors. Force-feeding diluted milk, liver juice and small amounts of yeast has brought about recovery of animals in which the disease has progressed to the ataxic or even to the paralytic stage. Recent field trials of synthetic vitamin B_1 as a specific therapeutic agent have produced very favorable results.

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[4] J. J. Lingane and H. A. Laitinen, *Ind. Eng. Chem.*, Anal. Ed., 11: 504, 1939.

[5] J. Heyrovsky, "Polarographie," in W. Böttger, "Physikalische Methoden der Analytischen Chemie," Bd. 2, Akad. Verlagsgesellschaft, Leipzig, 1936.

[6] H. Hohn, "Chemische Analysen mit dem Polarographen," Verlag von Julius Springer, Berlin, 1937.

Pathologically, the most characteristic lesions are found in the central nervous system, and these have been used as a basis for routine diagnosis in our laboratories during the past five years. The diagnostic lesions occur almost invariably in bilaterally symmetrical locations. They are found ventral to the floor of the fourth ventricle, in the quadrigeminal plate, in certain nuclei just ventral and lateral to the aqueduct of Sylvius, in the thalamus and in certain locations in the cerebral cortex. Histologically, they are characterized by striking vascular changes which affect the smaller vessels. Irregular dilatation or varicose deformity occurs, together with a very marked proliferative reaction involving particularly the endothelial cells, but also, to some extent, the adventitia. These vascular changes result in small, diffuse hemorrhages. A degeneration of nerve cells, with a variable degree of neuroglial reaction, accompanies the vascular changes. The lesions are definitely focal and occur only in certain nerve centers. In their distribution and histologic appearances they are the counterpart of the lesions of Wernicke's polioencephalitis of man.

Alexander[1] has presented convincing evidence, based on animal experimentation, that Wernicke's disease in man is due to a deficiency of vitamin B_1 in the presence of an adequate supply of other vitamins. A study of those diets that bring about a rapid termination of outbreaks of the dietary disease in foxes, as well as therapeutic trials with synthetic vitamin B_1, led us to conclude, independent of Alexander's investigations, that the dietary disease of foxes with which we were dealing with essentially a B_1 avitaminosis. The similarity of the pathologic changes in the brains of foxes with this disease and those in the brains of other animals with a vitamin-B_1 deficiency, as described by Alexander, lends further support to the view that a deficiency of vitamin B_1 is the cause of the disease in foxes. Since it is clear that the disease in foxes is brought about by their eating fish, we are led to the conclusion that the consuming of fish somehow produces a B_1 avitaminosis in foxes. The method by which it is brought about is not known, but that a deficiency does occur seems not unreasonable in the light of experimental and clinical data regarding B_1 avitaminoses in man and lower animals and in view of the chemical instability of thiamin. It seems a definite possibility that some substances in whole fresh fish and in alcoholic liquors are specifically destructive to vitamin B_1. A detailed consideration of facts relative to this point will be presented elsewhere.

SUMMARY

A common and highly destructive dietary disease of silver foxes in captivity is pathologically the counterpart of Wernicke's hemorrhagic polioencephalitis of man. The disease in foxes is caused by feeding fish as 10 per cent., or more, of the diet. It is probable that the fish induce a B_1 avitaminosis which causes the characteristic pathology and the resultant symptoms.

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[1] Leo Alexander, *Am. Jour. Path.*, 16(1): 61–69, January, 1940.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE METHOD FOR PREPARING ANTIGENIC SUBSTANCES FROM THE TYPHOID BACILLUS

IN several laboratories material has been isolated from the typhoid bacillus, *Eberthella typhosa*, which has proved antigenic when injected into small animals and, in some cases, in man. In general, the methods used may be divided into three groups: (1) fractionation of a tryptic digest of the organisms (Douglas and Fleming,[1] Raistrick and Topley,[2] Wakeman[3]), (2) fractionation of a trichloroacetic acid extract of the bacilli (Boivin and coworkers[4]), and (3) dissociation and extraction of the active material by organic solvents such as diethylene glycol (Morgan[5])[6]. An examination of the methods used and the products obtained indicates that the chief problem is the removal of protein from an antigenic complex largely carbohydrate in nature.

We describe here a different procedure, simple and rapid, which has proved useful for the examination of the antigenic constituents of several microorganisms and should be generally applicable to many others.

---

[1] S. R. Douglas and A. Fleming, *Brit. Jour. Exp. Path.*, 2: 131, 1921.

[2] H. Raistrick and W. W. C. Topley, *Brit. Jour. Exp. Path.*, 15: 113, 1934.

[3] F. B. Wakeman, *Military Surgeon*, 84: 318, 452, 1939.

[4] A. Boivin and L. Mesrobeanu, *Rev. d'Immunol.*, 1: 553, 1935.

[5] W. T. J. Morgan, *Biochem. Jour.*, 31: 2003, 1937.

[6] The use of concentrated urea solutions to dissociate and extract the antigen has been described recently by J. Walker (*Biochem. Jour.*, 34: 325, 1940).

Concentrated phenols are known to be good solvents for most proteins. This fact, together with our observation that many complex polysaccharides, such as gum acacia, pectic acid, gum karaya, chondroitinsulfuric acid, etc., are insoluble in strong phenol solutions, suggested the possibility of the use of phenol in the purification of carbohydrates of bacterial origin. We found that the capsular polysaccharides of most of the types of pneumococci are insoluble in concentrated phenol and may easily be separated from associated proteins by extraction of the latter in phenol; the polysaccharides which are soluble in phenol have been similarly purified by fractional precipitation from phenol solutions by alcohol or glacial acetic acid. (The use of this method in the preparation of the type-specific polysaccharides of pneumococci will be the subject of a separate communication elsewhere.) Applying this method to dried typhoid bacilli, we have obtained a substance, probably still crude in nature, which is highly antigenic in mice.

Acetone-dried organisms of the U. S. Army Medical School strain 58 (Panama carrier strain) were repeatedly extracted with U. S. P. liquified phenol (88 per cent.), or better still, with 95 per cent. phenol, then with alcohol to remove phenol. The phenol-insoluble residue was dried with acetone, then extracted with neutral physiological saline (0.9 per cent. NaCl) or with water; the extract was clarified and precipitated with alcohol or alcohol-ether in the presence of sodium acetate. The precipitate was then subjected to a second phenol extraction, and the alcohol-washing, water extraction, clarification and precipitation were repeated. The final product (substance A) after drying with acetone is a fluffy white powder, which readily forms a viscous, faintly opalescent 1 per cent. solution in water or physiological saline.

Phenol extraction may likewise be used on the product obtained by the tryptic digestion procedure. A tryptic digest preparation, made according to Wakeman,[3] gave a weak biuret reaction; one treatment with phenol removed the small amount of material responsible for this reaction. After clarification of the water extract of the phenol-insoluble residue, precipitation and drying, a product (substance B) was obtained which closely resembled substance A in appearance and properties.

Both substances, obtained in yields of 10 to 15 per cent. of the weight of the organisms, give negative or very faint biuret reactions and very strong Molisch reactions. Their nitrogen contents, corrected for ash and moisture, are 3.4 to 3.6 per cent. Hexosamine, if present at all, accounts for less than 10 per cent. of the total nitrogen. Both substances give strong precipitin reactions with antityphoid rabbit serum.

At least 50 per cent. of 88 white mice injected with two doses of 4×10^{-7} mg of either substance A or B were protected from an infective dose of 5×10^{4} live organisms of strain 58 suspended in mucin. At least half a control group of 40 mice were killed by 10 to 100 organisms similarly suspended. The immunizing doses were given one week apart and the infective dose one week after the second immunizing dose; the animals were then observed one week further. All injections were made intraperitoneally. The phenol-soluble material gave equal protection only in doses 10 to 1,000 times greater.

The antigenic power of substance A at least equals that of material we have prepared by Wakeman's method. Solutions containing 1 mg of active material per ml of physiological saline retain their antigenicity upon passing through a Berkefeld N filter.

Like the products described by others, our antigens were found to be toxic. In preliminary determinations of acute toxicity, a single intraperitoneal dose of 0.4 mg of substance A or B killed about 50 per cent. of 40 white mice within 24 hours. The injection of 0.1 mg under the skin of the abdomen of each of 10 guinea pigs caused a slight reddening and induration over the site of injection lasting one day in one animal and two days in another; the other animals showed no reactions. Intravenous doses of 0.1 mg in rabbits caused the death of two of ten rabbits within two hours and an average maximal elevation of temperature in the others of 2.2° F.

Further reports on the chemical, immunological and toxic properties of these substances will appear later.

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Belgodere, Francisco Javier A. *La Verdad, la Ciencia y la Filosofia.* (Tratado de Euristica Razonada.) Pp. 256. S. Turanzas del Valle, Mesones 97, Mexico.

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WHAT IS SOCIAL SCIENCE?

By Professor **EDWIN B. WILSON**

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LIKE many another English word, science is used in a variety of senses from knowledge or comprehension to art or skill and its meaning in any context must be judged from that context. The usual meaning seems to be knowledge gained by systematic observation or knowledge coordinated and systematized, *i.e.*, science, referring whether to method of gaining knowledge or to a body of knowledge, implies something more than sporadic activity. There is often contrast between science and art as may be illustrated by a quotation from Ruskin ("The Eagle's Nest"):

> In science you must not talk before you know. In art you must not talk before you do. In literature you must not talk before you think. . . . Science—the knowledge of things, whether Ideal or Substantial. Art—the modification of Substantial things by our Substantial Power. Literature—the modification of Ideal things by our Ideal Power.

It will be noted that Ruskin does not here emphasize the systematic nature of that knowledge which is science, but inasmuch as without a certain degree of continuity there could hardly be art or literature I take it that the passage must imply the same of science.[1]

---

[1] Whether it is justifiable to place this interpretation on Ruskin's words may be questioned. Certainly his primary definition of science is sheer factual knowledge. "It is not the arrangement of new systems, nor the discovery of new facts, which constitutes a man of science; but the submission to an eternal system; and the proper grasp of the facts already known." (Art. 37) "We are so much, by the chances of our time, accustomed to think of science as a process of discovery, that I am sure some of you must have been gravely disconcerted by my requesting, and will to-day be more disconcerted by my firmly recommending, you to use the word, and reserve the

There is often an antithesis drawn between pure and applied science of much the same import as that which Ruskin draws between science and art. The physicist is interested in physics as physics without regard to what he can do with that knowledge other than develop more physics; the engineer takes the physics and uses it for his engineering purpose. It is safe also to say that the engineer has to use something besides physics, he has to use his judgment in applying physics to his engineering purposes, and this means that he is in part at least an artist. In the same way medical practice has to be more than an application of unmodified medical science. Such a difference may be illustrated, perhaps with overemphasis, if one asks about the science versus the practice of billiards or golf. The science of golf is a matter of ballistics of an elastic body impelled by a blow from an elastic body and moving through an elastic and resisting medium to strike the earth and move on. This is a very complicated situation requiring for its discussion a deal of complicated mathematics, some of which was supplied by P. G. Tait, some more by subsequent writers, and some not yet available. It is not clear that the perusal of Tait's work could be of any assistance to a golfer in playing his game; indeed, I imagine that few golfers could follow Tait's theory and surely one would not require the science as a prerequisite to that practice by which the art of good golfing is acquired. Here the pure and applied sciences are probably, as in much of medicine and in some of engineering, largely dissociated; it is to be doubted if Tait became a better golfer by virtue of his profound studies, it is probable that the studies were suggested through his interest in the game and his intellectual curiosity to ascertain how much of the game he could explain by application of his mathematical technique.

According to the "Century Dictionary" social science is:

> The science of all that relates to the social condition, the relations and the institutions which are involved in man's existence and his well-being as a member of an organized community. It concerns itself more specially with questions relating to the public health, education, labor, punishment of crime, reforming criminals, pauperism and the like. It thus deals with the effect of existing social forces and their result on the general well being of the community, without directly discussing or expounding the theories or examining the problems of sociology, of which it may be considered a branch.

Another dictionary might well give another definition. Some persons would say that the social sciences were economics, government or political science, history, sociology, social psychology and cultural anthropology—omitting education, public health, law, administration and other topics or perchance including them. Others might say that social science dealt scientifically with social situations, *i.e.*, with situations involving more than one person. It may be entertaining to note that according to the "Century Dictionary" economics is the "dismal science," which is annotated "humorous" without vouchsafing any information as to whether this humorous use of dismal refers to "gloom, melancholy, dolor" or to "a tract of land, swampy in character, often covered by a considerable thickness of half-decayed wood and saturated with water."

For whatever meaning may be attached to the word social science, it would seem that the significance of the noun science is at least as crucial as that of the adjective social; and as it has been seen that this noun is used in a great variety of senses and further as we are aware that most of whatever may be social science probably appears in written form, we may perhaps be permitted to examine the meaning of social science in the light of Ruskin's definitions: In science you must not talk before you know. In art you must not talk before you do. In literature you must not talk before you think.

Consider Plato's "Republic." The reason I invite your consideration of this work is because I rarely have attended a doctoral examination in the social science field but what the candidate has been asked questions respecting it. From this I infer that Plato's "Republic" must be a contribution of so great importance to social scientists that they expect their students to be familiar with it. This seems not to be true of the "Lamentations" of Jeremiah or of the "Revelation" according to St. John. How would the "Republic" classify under Ruskin's trilogy? Did Plato here talk before he knew? If so we can not rate it as science. How could he have known some of the things of which he talked—as, for example, of the communism of

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thought of science for the acquaintance with things long since discovered, and established as true.'' (Art. 65) While such statements could be interpreted as limiting science as he uses it to facts, phrases like ''proper grasp'' may imply a considerable continuity or systematization of the knowledge. Further there are passages like that in Art. 134 in which Ruskin calls upon scientists to explain the formation of bubbles—something that really implies the inclusion of established theory as a part of our established knowledge. So, too: ''Science does its duty, not in telling us the causes of sunspots; but in explaining to us the laws of our own life, and the consequences of their violation.'' (Art. 206) And theology is placed as the highest of the sciences: ''The *effect*, for instance, upon your temper, intellect, and conduct during the day, of your going to chapel with or without belief in the efficacy of prayer, is just as much a subject of definite science, as the effect of your breakfast on the coats of your stomach.'' (Art. 67.) So far as concerns the artist in his work Ruskin specifically limits more sharply the meaning of science to facts concerning the looks of things: ''I told you that I did not mean by 'science' such knowledge as that triangles on equal bases and between parallels are equal, but such knowledge as that the stars in Cassiopeia are in the form of a W.'' (Art. 124) property and of children among the ruling class? What criteria of knowledge could be applied of so biting a character as would drive other observers to draw the same inferences? As a matter of fact did not Aristotle draw quite the opposite inferences? And who shall decide and how shall he decide between Plato and Aristotle? In making a scientific decision one looks to the facts for enlightenment and for direction. *It seems, at least to me, that we have to infer that* Plato had not the facts, that he was expressing opinion about many matters on which it would be almost impossible to bring facts to bear—almost though conceivably not quite so difficult as to bring them to bear upon some of the matters in the "Revelation."

I infer therefore that Plato's "Republic" is not science. Is it art? That is, did Plato *do* before he talked? Had he an experience in social action whereby what he said could be rated fairly as a modification of substantial things by his substantial power? You may have information or inspiration on which you would answer: Yes. I have not and should be obliged to answer: No. On the other hand it does seem clear to me that Plato had thought before he wrote and that his "Republic" may well be characterized as a modification of ideal things by his ideal power and hence should be rated as a work in social literature. Indeed so great is the ideal power which shines out over the ideal things, so greatly are these things modified by that power, that none would hesitate ranking the work well toward the top of social literature.

We might turn next to F. S. Oliver's "The Endless Adventure" which is an account of Walpole's administration of the government of England. As I read this work it is a penetrating analysis of action—not Oliver's, to be sure, but Walpole's. In this respect the work differs from writings of Lord Haldane or of Lord Chesterfield on public administration, or of Chester Barnard on the function of the executive, all of whom actively engaged in administration; they did before they talked. However, we do not have much serious writing at an academic level by those active in public life or in business and I believe that in applying Ruskin's classification we should include in science, art and literature respectively the work of those who discuss the knowledge, action or thought of others. Where I asked above: Did Plato do before he talked, I had as lief ask: Had anybody done these things of which Plato talked? With this understanding we should classify Oliver's work as one of social art. In so doing I would not imply that Oliver does not propose some working hypotheses with respect to principles of action in the political field which if substantiated would be scientific laws of such action. Nor do I suggest that Oliver's work itself is not literature. All I am trying to do is to classify it essentially in the spirit of Ruskin's statement.

Let us try W. G. Sumner's "Folkways." As its name indicates this deals with the behavior of peoples. The author collected from many sources, compared and arranged for his undergraduate course a variety of folkways. He was not trying to show how various peoples ought to behave, but rather how they did behave and what values they held. The book should I think be rated as social science—at the descriptive or taxonomic level. *It has not all the systematization* or coordination which we might like to see applied to the field of its interest, but that is true of many a good text in science. It has not a theory attached to it as printed. Sumner once told me it was a case book and that if he lived long enough he might follow it with a theory of society. Theories that precede cases like Plato's "Republic" are very likely to be literature, a collection of cases that precedes theory may well rate as scientific data. Herbert Spencer had an evolutionary theory of society which he tried to substantiate to some degree with facts, but it is my belief that to-day most sociologists regard the known facts as not competent to prove the evolutionary theory of society in any such sense as the known biological facts prove the theory of biological evolution.

The literary tradition in the social sciences is very strong. By this I most certainly do not mean the tradition of fine literature. Those who practice the literary tradition may be very indifferent writers and very indifferent thinkers—they are merely those who deal with modifications of ideal things by their ideal power, however limited, with no particular control over those processes by facts, indulging in lengthy dialectic, often extremely clever, without starting from nor ever coming to statements which could be controlled by facts. Indeed unless I am much mistaken, so great is the prestige of this sort of thinking and writing on the part of those who are in a position to award recognition for work in social lines that many a young fellow might better imitate Plato's "Republic" badly than Sumner's "Folkways" well; yet if we are to advance *scientifically in the narrow sense it would* more likely be through constant revision, systematization and extension of the "Folkways."

Not long ago I was sitting with a group of thoughtful persons, mostly educators, when one of them asked another: What do people up your way think of the present European situation? His reply was: They don't think, they merely *emote.* I know of the transitive verb *emove,* though it is rare; I can find little justification for the intransitive *emote,* but it seems to be coming sparingly into use and perchance before long it will be in good usage. We need some word for abandoning one's self to one's emotions, for this is a common phenomenon. Many is the time that one does not know, nor do, nor think, but does *emote.* Maybe it should not be so. Maybe in those quiet

Victorian days Ruskin would not have done so nor admitted that any English gentleman would do so. The forebrain was then supposed to have ascendency over the midbrain and passion to be thereby restrained. Still this may have been a condition contrary to fact. Persons were supposed to be logical, but non-logical actions were then presumably very common as they are now. If in science one does not talk until he knows, in art until he does and in literature until he thinks, in what shall we say it is that one does not talk until he *emotes*? We need a word for that something, and I daresay the Greeks may not have had a name for it.

Consider Marx's "Communist Manifesto" written when he was twenty-nine. I shall not cite his "Kapital" which appeared twenty years later. The "Manifesto" is a diatribe against the bourgeoisie. However much it may be founded on knowledge, action or thought, its form and spirit appear to me to be in the same class as the hellfire and damnation sermons which are said to have been frequent right here in New England in earlier days; it is a work of a modern Hebrew prophet calling upon the people to renounce Baal and his idolatries and follow only the true Jehovah of whom Marx offers himself as the true prophet. It is shot through with emotion and is an appeal to emotions. And when we use the term emotion here we are not thinking of the rich sensuousness of art, nor of the strong sentiment of literature, and still less are we thinking of the intellectual estheticism of science; we are in the presence of hate and perchance of rage—as of one who hates the devil and rages against all his works. Where would Ruskin place the "Manifesto"? Where would he place "Nine long Harvards and three times three" which ring out these Autumn Saturday afternoons? So far as I gather the meaning of the "Eagle's Nest," I judge he had small place for them.

Just as we may need the word *emote* to signify abandonment to emotional reactions so we may need a word to denote those verbal productions which come direct from emotion and are intended to appeal directly to the emotions of the hearer or reader and thereby to incite him by sympathy to action. Shall we call them slogans or emotives or propaganda? Shall we supplement Ruskin and say: In propaganda you must not talk before you emote? At any rate, whatever be the terminology adopted I think we must readily agree that there is here something important which should be pointed out. In particular it should be pointed out for the purposes of this discussion of "What is Social Science" because it is surely true that the phrase social science as used to-day covers not only Ruskin's three gentlemanly categories but this fourth which we have been trying to portray and which may be socially more influential than the other three put together in about that proportion by which the proletarians exceed the bourgeoisie in the population. And shall we add to the definition of Art as the modification of Substantial things by our Substantial Power and to that of Literature as the modification of Ideal things by our Ideal Power a definition of propaganda as the modification of Substantial things by our Ideal Power, which may well be a polite characterization of lies, or as the modification of Ideal things by our Substantial Power, which might be a fair definition of forcible indoctrination?

If we use science in the strict sense of knowledge systematized and coordinated and generally accepted by professionally competent persons we have, I fear, to admit that there is very little social science. Many a time I have sat at the Social Science Research Council or at committee meetings at Harvard or elsewhere, when in groups of social scientists the conversation has turned to questions of their science. Under such circumstances one generally listens to disputes between different opinions which those participating hold and try to substantiate, each against the others, by appeal to reason or argument rather than by appeal to facts. If perchance somebody should point out that among natural scientists there would be more general agreement, the answer comes back that the questions under discussion are on the border line of research and that agreement should not be expected any more than a few years ago agreement on the meaning of experiments on cosmic rays was attainable as between Millikan and Arthur Compton or agreement as to the expanding, contracting, vibrating or stationary universe could be had between astronomers. It is of course a just observation that we do not expect agreement at the research line. If, however, one counters this observation by asking what it is that is known scientifically in the social field, the reply is something vague—such as that "there is a great body of economic science on which all or most economists are in agreement as is true of physics." When, however, one gets down to brass tacks and presses for the specification of something agreed upon from out of this great body of economic knowledge, one finds hesitancy; and if by an excess of daring some member of the group ventures some definite proposition as known, his confrères cry out that they do not agree. Statistically speaking, I have seen this sort of thing happen often enough under serious circumstances and have seen the contrary, namely, the successful specification of scientific knowledge, occur so infrequently that I am led to my inference that there is not much that is social science. There are, to be sure, as always, possible avenues of escape from such a particular inference; one might, for example, conclude that the social scientist is simply not interested in whatever it is that is known.

To me this would not be so ominous a situation were it not that some of those least able or willing to concentrate on the scientific content of their science are among those most actively advocating social and economic control. Now while it is true that we have had and still have some empirical forms of materialistic control without a sound basis in natural science we have come from experience to know that such empirical control is validated only when it has been tried and has been observed to work time and time again so that each particular realized form of such control has attained that kind of uniformity of success which itself represents a scientific fact, and we do not expect a new attempt to be successful unless it is but a very slight modification of an old form; but on the other hand from the rapid and successful advances of the past century we have acquired the belief that the surest and safest way to gain new forms of control is through basing them soundly on ascertained science. How the situation in the social field can be different is difficult to see; those who advocate new types of social control may advocate them as experiments (though they rarely do, for they generally advocate them as rights or duties), but must be prepared for serious failure to achieve ends and even for the appearance of tragedies—unless and until a social science has been developed from which the results of the experiment can be predicted with assurance.

Turning now from social science in the strictly scientific sense we find a great deal of social science of the literary type, of which some might be converted into true science by careful investigation but of which much seems not to be so formulated as to admit of this conversion. And there is also a great deal of social art or action which might be so subjected to study as to yield accredited science. A scientist is a fellow who has technical competence to give a proof which is valid. In this connection I would refer to Chester Barnard who writes:[2]

> Whether the present essay is a contribution to the science hoped for remains to be determined by others. What has been presented is a hypothetical scheme which at present explains roughly to me what I have observed in many years of practical work with organizations of various kinds and what I have constructed from the experience of others, supplemented, of course, by a little knowledge of the social sciences. It is not the work of a scientist or scholar, but rather of an interested student of affairs.
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> For this reason perhaps its chief value, if presently it has any, will merely lie in its expression of one view of experience. By it I have at least submitted my mental processes in this field to inspection. If it has any further value it will lie in the suggestion it may give to more competent inquiry, which I hope can be undertaken.

The work may not be science, the author does not rate it as such and I have ventured to follow him in this; but it is written more in the scientific spirit than many a work by a professional social scientist and is, I believe, in such form that it can be put to the tests that will convert it into science. Are there persons who have the technique and the interest to take up the author's invitation?

When my father was a student at Yale College, 1861–1865, the curriculum was largely classical. Greek, Latin, mathematics and rhetoric were the mental pabulum of the first two years. In the third year they continued with the addition of some natural science which went on into the senior year. The only subjects which could be considered as social science were in this last year. Here we find in the first of the three terms:

History and political philosophy—Guizot's "History of Civilization," political economy begun, 4 lectures a week for 7 weeks by Pres. Woolsey;

Mental philosophy—Hamilton's "Metaphysics," 4 lectures a week for 7 weeks by Prof. Porter, later president.

In the second term we find:

History and political philosophy—Political Economy finished, Lieber's "Civil Liberty and Self Government," 4 lectures a week for 7 weeks by Pres. Woolsey;

Moral philosophy—Stewart's "Active and Moral Powers," Butler's "Sermons," Hopkins' "Moral Science," 4 lectures a week for 7 weeks by Prof. Porter;

Theology—Paley's "Natural Theology," Butler's "Analogy."

In the *final Senior term*:

Political philosophy—Law of Nations;
Constitution of the United States;
Theology—Paley's "Evidences of Christianity."

I cite this program as indicating the climax of college education in those days at what was undoubtedly one of our best colleges. The catalogue listed no professor of social science—the President took this rôle—and presumably very ably, he was a real man. Porter was professor of moral philosophy and metaphysics; he was also in the faculty of divinity. W. B. Clarke who taught theology to the seniors was professor of divinity but his name does not appear in the list of that faculty, only in the list of the faculty of the academical department. Dutton who gave the fourteen lectures on the Constitution was from the faculty of law and his name does not appear among those of the faculty of the academical department. The point which I would make is that the social and moral sciences or philosophies were apparently treated along with theology as comparable and culminating parts of a liberal education. There is little likelihood that the scientific aspects of any of them were emphasized but the maturity and caliber of the men who gave them and the high standard of the texts which were used is adequate evidence that they were good liberal education. Moreover, when estimating what the students on graduation knew about man one must take into account the tradition of education in the classics at that time which was to give attention to the life and ideas of ancient times—the reading of Thucydides was not just an exercise in the Greek language or literature but one in the interpretation of history.

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[2] "Function of the Executive," p. 292.

The situation of the social subjects in the colleges to-day is very different. There are numerous courses and a large staff. The increase in the time given by undergraduates to the social studies has been very great, until at the present time the concentration in these fields amounts in some colleges to about one half of the whole. There is great attention to current and recent problems whereas as of my father's time there seems to have been relatively little. That those of our students who concentrate to-day in the social fields learn far more of their detail than students learned seventy-five years ago is certain, but it seems equally certain that those who concentrate in other fields by the very intensity of their concentration may have a far less philosophic outlook upon society than did all the students of those days. What the place of the social studies is or should be in present collegiate education I am not prepared at this time to discuss; were I to discuss it I should probably make some plea for a greater attention to law, education, public health, and possibly administration difficult though that subject is, than is usually accorded to them in such discussions. Furthermore, no matter how much I would emphasize the necessity for professionals to lay more stress on the strictly scientific aspects of social science or however much I might urge that even the collegian might be shown what is definitely known, I should be likely to suggest that where so little is known it would be well to consider the social sciences not as individual branches of learning but as an interest in man, reaching out even to theology as they did at Yale—for who shall assert that man lives by bread alone or that an ideology that triumphs over material conditions does not have to approach to a religion?

ISOSTATIC CONTROL OF FLUCTUATIONS OF SEA LEVEL

By Professor **ANDREW C. LAWSON**
UNIVERSITY OF CALIFORNIA

With the last retreat of the North American continental ice sheets the northerly drainage of the land was impounded by the ice front at various stages till, with the vanishing of the ice, it finally flowed freely to the ocean. The lakes so formed waxed in size as the ice front receded; but the only escape for their waters was to the south, over cols in the continental divide. There were many of these lakes, large and small, each with its own level of overflow, which remained approximately constant as the lake expanded. The shores of all of them, as they came against the emerging land slope of their respective basins, carved or built shore features, which are in most cases perfectly preserved to this day. At the time of their formation these shore features were of course level, but to-day they are for long stretches inclined to the horizon, up to the north. This inclination of the once level strand lines is due to a tilting of the surface of the earth, and affords an angular measure of the tilt, which is usually expressed in inches or feet per mile. The constant display of tilt up to the north, on the periphery of basins vacated by continental ice sheets to form lakes, has suggested to geologists that the rise is due to relief of load, consequent on the vanishing of the ice and the complete or partial draining of the lakes. This belief is now very generally held. It means that geologists have accepted the view that the earth's crust may be depressed by a local load upon its surface, and recover from the depression when the load is removed. That is, they have accepted isostasy as a valid doctrine. The phenomena of regularly titlted shore lines are perhaps the most impressive and convincing proof of the truth of that doctrine.

Isostasy means equality of mass, per unit of horizontal cross section, in all large vertical columns of the earth. The imposition in the Pleistocene of a broad load of ice, let us say one kilometer thick, upon a portion of the earth's surface threw the column carrying that load out of balance with the rest of the earth. The ice mass came from the ocean; and the column, the top of which is the sea surface, lost load, and was thus also thrown out of balance with the rest of the earth. The unglaciated portions of the continents were neither loaded nor relieved of load, but in glacial time they were nevertheless also temporarily out of balance with both glaciated and oceanic regions, in different degree. The whole disturbance was caused primarily by the transfer of load from the ocean to the glaciated region. If a load equivalent to that of the ice had been shifted in depth from below the ice to the region below the ocean, with uniform distribution as to both removal and addition, balance would have been restored over the whole earth. Since the gravitative tendency to restore isostatic balance, however disturbed, is always active, it is presumed that continental glaciation actually induced the shift of mass in depth from the loaded continental column to the unloaded oceanic column. The volume of the rock mass, thus removed in depth from the glaciated continental column, was less than that of the ice since its density is greater. Volume may be spoken of in terms of thickness, the layers we have to deal with being uniformly thick. Thus the thickness of 1 km of ice of density .917 added to the surface would be compensated by the removal in depth of .278 km of rock of density 3.3 and its distribution to other columns of less mass.

The compensating movement would have set in long before the full accumulation of the ice load, and it would at first have been directed toward both the ocean and the unglaciated portions of the continents. But as compensation for the full load advanced toward completion, the shift of mass in depth would have been from the continents as a whole to the oceanic column, till world-wide balance was re-established. At this stage, assuming that the full ice load continued for a time, the sea level, as compared with its pre-glacial position, would have been lower by the thickness of the layer of water removed to form the glaciers, less the rise of the sea bottom due to the invasion of the column in depth by heavy rock for compensation.

At this stage of universal balance, the surface of the unglaciated continental column would have had the same position, with reference to the center of the earth, that it had in pre-glacial time. The surface of the glaciated column would have been higher and, as already stated, the surface of the oceanic column lower. The mass added to the oceanic column would have been distributed over its entire area, as was the water that went to form the ice sheets. It is difficult to imagine any method of distribution of rock mass from the continental columns to the oceanic column other than plastic flow. The transfer of mass does not imply that the same rock taken from the continental column was delivered to the oceanic column, but only that equality of mass in the two columns was re-established by plastic adjustment.

The problem of how plastic shift of mass in depth, induced by shift of load at the surface, affects the level of the ocean involves the use of data which are not yet fully or certainly determined. Thus the density of the heavy rock, which in depth compensates the oceanic column for loss or gain of sea water, is but vaguely known. Its specific gravity is at least 3.3, and this value is used in the calculations which follow. The arithmetical value arrived at for the fluctuation of sea level lacks precision, but that the fluctuation is real and is isostatically controlled can scarcely be questioned.

An approximation to the mean thickness of the Pleistocene ice sheets at their maximum may be obtained by considering the Greenland sheet of to-day. Lauge Koch gives us a map[1] of Greenland with a few contours on the surface of the ice. The average gradient of this surface, measured on six different lines between the 3,000 m and the 2,000 m contours, is 1 in 459. But the ice front except in the fjords moves very slowly, if at all, and Coleman[2] cites Koch to the effect that it is about stationary.

The Labrador ice sheet flowed from its center of dispersion to and beyond the mouth of the Hudson River. H. L. Fairchild[3] places the maximum post-glacial uplift at Lat. 50°, Long. 75°. But A. P. Low[4] located the center of dispersion of the ice between Lat. 53° and 55°. A probable position for the center is thus Lat. 54°, Long. 75°. The distance from this point to the mouth of the Hudson River is 1,500 km. The present altitude of this center is not precisely known. But Low gives the altitude of Lake Mistassini as 1,300 feet. The mean altitude of the region around the lake is about 300 feet[5] above its surface. This gives us 1,600 feet or about .5 km above present sea level.

When the front of the Labrador sheet, in the wane of the latter, withdrew from the ocean at the mouth of the Hudson River, it occupied a succession of positions in its retreat, at each of which waste just balanced the forward flow of the ice. One of these positions was the present shore line at New York. Then, considering the front as stationary for a brief time, the gradient of the surface of the ice was probably about the same as that of the Greenland sheet to-day, 1 : 459. Then the ice surface at the center of dispersion would have been $\frac{1}{459} \times 1{,}500 = 3.27$ km higher than at the front. We may suppose that at this stage the surface of the Labrador sheet at its front was .3 km above present sea level, and that at this, or any other stage of the early retreat, the thickness of the ice at the front was also .3 km. Then the center of dispersion was $3.27 + .3 = 3.57$ km above the contour of the present shore. The load of ice isostatically displaced an equal mass of heavy rock in depth, having a specific gravity assumed to be 3.3; and there was a depression of the region corresponding to the thickness of the heavy rock displaced. If x be the thickness of the ice at the center of dispersion, $x = 3.57 - .5 + \frac{.917x}{3.3}$, whence $x = 4.3$ km; and the mean thickness of the ice from the center of dispersion to the mouth of the Hudson River was about $\frac{4.4 + .3}{2} = 2.35$ km.

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[1] *Jour. Geol.*, 31: 48, 1923. Reproduced by Coleman in his "Ice Ages Recent and Ancient," p. 29, 1926.

[2] *Op. cit.*, p. 28.

[3] *Bull. Geol. Soc. Amer.*, 29: 187–234, 1918.

[4] *Geol. Survey Can. Ann. Rpt.*, viii, p. 387 L., 1897.

[5] A. P. Low, *op. cit.*, p. 68 L.

But this thickness is that of a sheet having the same gradient as the Greenland sheet, or 1:459; and the front of the Greenland sheet is stationary. For maximum vigor of both Greenland and Labrador sheets, the supposition may be made that the mean thickness was 50 per cent. greater than that which corresponds to a gradient of 1:459. On this assumption the Labrador sheet at its maximum would have had a mean thickness of $2.35 \times 1.5 = 3.52$ km. If now, for the maximum vigor of the Labrador sheet, x be the thickness of ice at the center of dispersion and .3 km be taken as the thickness at the front, out in the Atlantic, then the mean thickness is $\frac{x+.3}{2}$. Thus, $\frac{x+.3}{2} = 3.52$, whence $x = 6.74$ km. For this load the isostatic depression was $\frac{6.74 \times .917}{3.3} = 1.87$ km; and the altitude of the ice surface at the center of dispersion was $6.74 + .5 - 2.04 = 5.2$ km. The gradient of the Labrador sheet at this maximum stage depends on how far the front had advanced beyond the line of the present shore.

If the mean thickness of the Labrador sheet at its maximum be assumed to have been 3.52 km, we may, to extend the discussion, adopt this figure for the mean thickness of all continental ice sheets at the height of pleistocene glaciation. Coleman[6] gives the area covered by continental ice in Pleistocene time as 12,000,000 square miles or 31,000,000 square kilometers. The volume of this ice is $31{,}000{,}000 \times 3.52 = 109{,}120{,}000$ cubic kilometers. To supply this ice a layer of water $\frac{109.12 \times .917}{368} = .27$ km thick was removed from the ocean, the extent of the ocean being 368,000,000 sq. km and the expansion of water on freezing $\frac{1}{12}$. The removal of this load of water would have necessitated the addition in depth of a layer of heavy rock, of specific gravity, say 3.3, for isostatic compensation. This layer of rock added to the oceanic column would have had a thickness of $\frac{.27}{3.3} = .08$ km, and would have raised the sea bottom that much. The net fall of sea level, relatively to the center of the earth, or to the pre-glacial sea level, was $.27 - .08 = .19$ km. The layer of rock added to the oceanic column had the same mass and the same volume as that forced out of the continental columns to compensate the load of ice.

Of the total area (31,000,000 sq. km) covered by ice sheets in the Pleistocene one half has been completely deglaciated, and the ice still remaining on the other half, comprising Antarctica and Greenland, has been reduced in thickness. The reduction may be again taken, for the purposes of this discussion, at about one third of the maximum. That is, the mean thickness of existing ice sheets, covering an area of 15,500,000 sq. km, is supposed to be 2.35 km instead of the 3.52 km at maximum glaciation. The total volume of ice thus restored to the ocean since the maximum Pleistocene glaciation is about 72,740,000 cu. km. As water spread over the ocean it is a layer $\frac{72.74 \times .917}{368} = .18$ km thick; and if no other movement occurred the sea level would be raised that much. But this load of .18 km of water has been, or is in process of being, compensated by the removal from the oceanic column in depth of a layer of heavy rock. The thickness of this layer, at the assumed density of 3.3, is $\frac{.18}{3.3} = .05$ km; and the sea bottom would subside that much. Thus the net rise of sea level due to the waning and partial melting of the Pleistocene ice sheets, up to the present, is $.18 - .05 = .13$ km. For the total rise of sea level in this time we must of course add the effect due to the delivery to the ocean of the products of ordinary stream erosion.

OBITUARY

LEE CLEVELAND CORBETT

THE death of Dr. Lee Cleveland Corbett, which occurred on July 13, 1940, at his home in Takoma Park, D. C., came as a surprise to most of his friends. Though it was known following his return on the first of April from Florida that he was not well, few realized that his condition was critical.

The principal steps of Dr. Corbett's professional career after graduating from Cornell University, College of Agriculture, in 1890, constitute a continuous progression. From 1891–3 he was assistant horticulturist at the Cornell University Experiment Station under Dr. L. H. Bailey. In 1893 he went to South Dakota in the pioneer period of agricultural education there, as professor of horticulture and forestry in the State Agricultural College and Experiment Station, where he remained two years, going in 1895 to the University of West Virginia as horticulturist, where he continued until April, 1901, when he was appointed as horticulturist in the U. S. Department of Agriculture.

By a then recent Act of Congress, the tract of land across the Potomac River from Washington to become known later as Arlington Farm, had been turned over to the Department of Agriculture. Dr. Corbett's chief assignment, and his principal activity for several years, was the development of this land for experimental purposes and the construction of the necessary buildings.

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[6] *Op. cit.*, p. 9.

It was on July 1, 1901, that the Bureau of Plant Industry came into official being and under it there were combined into a single major administrative organization the several independent plant divisions, the heads of which had previously reported directly to the secretary. Shortly after Dr. Corbett came to the department, the Office of Horticulture was organized under his direction as one of the coordinate units in the Bureau of Plant Industry and in which the vegetable work of the Department was placed. Later, investigations in floriculture and landscape gardening were added. As the pioneer work at Arlington Farm was gradually accomplished, thus requiring less of Dr. Corbett's attention, the vegetable and floricultural work was given an increasingly large proportion of his time. In 1913, he was appointed assistant chief of the Bureau of Plant Industry. At the same time the Office of Horticulture and the Office of Pomology were combined into a single administrative unit in charge of the late A. V. Stubenrauch. When the latter, in July, 1914, resigned to return as professor of pomology to the University of California with which he had previously been connected, Dr. Corbett rather gladly transferred back to division work, succeeding Mr. Stubenrauch as the administrative head of the Office of Horticulture and Pomology.

In the fall of 1920, he made a trip to England and the Continent, particularly France and Holland, visiting the nursery growing centers of these countries in the interests of the root-stock investigations which were being inaugurated here.

Dr. Corbett served as head of the Office of Horticulture and Pomology until November, 1928, when he welcomed a transfer from administrative work to a field of research in which he had long been greatly interested, namely, a study of the causes leading to the development of horticultural industries in particular areas and their subsequent history, including both advancement and decline in different instances. This involved the appraisal of many factors as the suitability of the varieties grown, time of ripening, competing crops, regional costs of production, distribution facilities and other factors which might influence trends in the industries under investigation. The most of his time until his retirement, January 31, 1938, was devoted to this line of research, but during the last year of his service, he made a three months' plant exploration trip to South America on a special assignment in the Bureau of Plant Industry.

In the earlier years of his professional work he was a prolific writer, being the author of a considerable number of bulletins from the South Dakota and West Virginia Experiment Stations, and of a much larger number relating principally to vegetable growing and ornamental horticulture after he came to the Department of Agriculture. He also contributed to several yearbooks of the department and to numerous publications outside the department; he was the author of two books—"Garden Farming," a rather comprehensive work on vegetable culture, and "Intensive Farming."

Dr. Corbett was born at Watkins, N. Y., on October 21, 1867. In addition to the degree of B.S. conferred on graduation from Cornell University, he received the degree of M.S. in 1896 from the same institution, and the honorary degree of doctor of agriculture in 1921 from the University of Maryland. He held membership in numerous scientific and other organizations, including the American Association for the Advancement of Science of which he was a fellow, Vegetable Growers' Association of America, American Society for Horticultural Science of which he was president in 1914, National Potato Association of America, National Geographic Society, Washington Academy of Sciences, Botanical Society of Washington, Cosmos Club, and others.

Surviving Dr. Corbett are his widow, Mrs. Louise Phillips Corbett, and five children by his deceased wife, Mrs. Evelyn Northrup Corbett—Ruth, Frances (Mrs. Colston E. Warne, Amherst, Mass.); Dr. Roger B., director, Extension Service, University of Connecticut, Storrs; Laurence W., with Northrup, King and Co., seedsmen, Minneapolis, Minn.; Lee Thurston, lawyer, Rochester, N. Y., and a number of grandchildren.

H. P. GOULD

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RECENT DEATHS

THE body of Dr. John Eliot Wolff, professor emeritus of geology at Harvard University, was found after a twenty-seven-hour search on August 12 in the Mojave Desert, where he had gone on a one-day camping trip. He was eighty-two years old.

DR. FREDERICK EHRENFELD, head of the department of geology and mineralogy at the University of Pennsylvania, a member of the faculty for forty-three years, died on August 16. He was sixty-eight years old.

DR. MILICENT WASHBURN SHINN, specialist in child psychology, editor of the *Overland Monthly* from 1883 to 1894, died on August 14 at the age of eighty-two years.

FRANKLIN HENRY HOOPER, editor-in-chief of the Encyclopaedia Britannica from 1932 until 1938, who was associated with the publication for thirty-nine years, died on August 14 from injuries received when struck by a truck. He was seventy-eight years old.

Arthur H. Fleming, lumber manufacturer of Los Angeles, died on August 11 at the age of eighty-four years. He gave a sum amounting to more than five million dollars to found the California Institute of Technology at Pasadena. Dr. R. A. Millikan, chairman of the executive committee of the institute, made the following tribute: "It takes great courage and boldness to start any new enterprise, and it was Mr. Fleming's energy and boldness that made it possible to start California Institute on its present type of career."

Sir Alfred Bourne, formerly professor of biology in the Presidency College, Madras, died on July 14 at the age of eighty years.

Dr. William Russell, emeritus professor of clinical medicine at the University of Edinburgh, past president of the Royal College of Physicians, died on August 11. He was eighty-eight years old.

SCIENTIFIC EVENTS

THE BEIT MEMORIAL FELLOWSHIPS

At a meeting of the trustees of the Beit Memorial Fellowships for Medical Research, which was held on July 17, Dr. A. J. Clark, professor of materia medica in the University of Edinburgh, was appointed a member of the Advisory Board in the place of Professor W. Bulloch, who resigned after twenty-nine years' service. Dr. Paul Fildes was appointed honorary secretary on the resignation of Professor T. R. Elliott, who had served for ten years. Out of the twenty-seven present fellows nine have at their own request given up their fellowships for more direct service during the war.

The following elections were made, all with permismission for each fellow to be relieved at any time for war work.

Senior Fellowship, (£700 a year)

T. A. H. Munro, M.B., Ch.B., F.R.C.P. (Edinburgh). To continue his studies of inheritance in mental disorders. At the Royal Eastern Counties Institution. Colchester.

Fourth Year Fellowships, (£500 a year)

J. G. Chalmers, B.Sc. (Glasgow). A.I.C. To continue his chemical studies of polycyclic hydrocarbons in experimental cancer formation. At the research department of the Glasgow Royal Cancer Hospital.

T. R. R. Mann, M.D. (Lwow, Poland), Ph.D. (Cambridge). To extend his work on intracellular metalloprotein compounds, especially of red blood cells. At the Molteno Institute of Biology, University of Cambridge.

Junior Fellowships, (£400 a year)

M. Abercrombie, B.A. (Oxford). Junior research fellow, Queen's College, Oxford. To study amputation neuromata and the degeneration and regeneration of mammalian nerves. At the department of zoology, University of Oxford.

D. A. K. Black, M.D. (Gold Medal) (St. Andrews) M.R.C.P. (London). Research student of Medical Research Council. To study metabolic and bone marrow changes in the repair of severe anemias. At the Nuffield department of medicine, Oxford.

G. C. Butler, Ph.D. (Toronto). 1851 Exhibition Science Research Scholar. To study the purification and properties of gonadotropic hormone from the pituitary gland. At the department of pathological chemistry, University College Hospital Medical School, London.

J. L. Madinaveitia, D.F. (Madrid), Ph.D. (Edinburgh). Honorary research follow in chemistry, Manchester University. To study diffusing factors in bacterial filtrates and snake venoms. At the department of chemistry, University of Manchester.

S. M. Partridge, B.Sc., Ph.D. (London). Lister Institute student in biochemistry. To study the chemical nature of the antigen of Shiga dysentery bacteria. At the Lister Institute of Preventive Medicine, University of London.

D. Whitteridge, B.A., B.M., B. Ch. (Oxford). Demonstrator in physiology, Oxford. To study electrical records from brain after concussion or severe injury. At the Nuffield department of surgery and the department of physiology, University of Oxford.

P. C. Williams, B. Sc. (London). Research grantee of Medical Research Council. To study pituitary hormones and their excretion in clinical pathological conditions. At the Courtauld Institute of Biochemistry, Middlesex Hospital, London.

THE TOTAL SOLAR ECLIPSE OF OCTOBER 1

An expedition will be sent to observe the total solar eclipse in Brazil on October 1, under the joint auspices of the National Geographic Society and the National Bureau of Standards, to be led by Dr. Irvine C. Gardner, chief of the Optical Instruments Section of the bureau. Other members of the party are: Dr. E. O. Hulburt, of the Naval Research Laboratory; Dr. Paul A. McNally, S.J., director of the Observatory of Georgetown College; Dr. Carl C. Kiess, spectroscopist, and Dr. Theodore R. Gilliland, radio research specialist, the National Bureau of Standards, and Richard H. Stewart, staff photographer of the *National Geographic Magazine*.

The expedition will sail on August 24 for Recife, Pernambuco. After reaching Recife it will journey overland by truck and automobile through the city of Campina Grande to the neighborhood of the village of Patos, nearly 200 miles from the coast. Patos lies five miles south of the center line of the total eclipse; the instruments will be set up directly on that line. The observation post will be in a plateau country in the heart of one of the most important cotton-growing regions. The presence at Patos of a cotton gin and staff men of an American cotton company will make it possible for the expedition to find facilities which otherwise would be lacking.

The announcement issued by the National Geographic Society points out:

> The total eclipse of the sun of October 1 offers unusual opportunities for satisfactory observation because it traverses a dry region in which weather conditions are likely to be favorable. The sun will be unusually high in the heavens (approximately 54°) at the time of totality, and the period of darkness will last for nearly five minutes. To take advantage of these conditions, the National Geographic-Bureau of Standards expedition has built two special spectrographs, each capable of photographing a portion of the sun's spectrum 40 inches long. In addition the expedition designed and built especially for the October 1 eclipse, two small, compact telescope-type corona cameras. These will be used to photograph the corona, the delicate halo that extends outward around the sun but which can be seen only during total eclipses. Included in the equipment also will be the large telescope camera designed by Dr. Gardner several years ago with which he has photographed solar eclipses on National Geographic Society expeditions in Russia, and on Canton Island in mid-Pacific.

After the eclipse the expedition will move to Campina Grande, a city of approximately 90,000 inhabitants, to carry on the necessary laboratory work in the development and preparation of the photographic films. The party will sail from Recife on its return voyage to the United States on October 14, and expects to reach New York about October 23.

THE DEDICATION OF THE NEW OYSTER LABORATORY AT MILFORD, CONNECTICUT

THE dedication on August 1 of the new oyster laboratory at Milford, Conn., of the Fish and Wildlife Service, as reported in *The Fisheries Bulletin*, marked a significant attainment in the twenty-three years of investigation of oyster problems in the general area of Long Island Sound. Oyster investigations at Milford were initiated in 1917, when the Connecticut Oyster Farms Company provided one room in their office building which was outfitted as a laboratory and used only during the summer months. Although the earlier investigations contributed a great deal toward the solution of various oyster-cultural problems, the program was handicapped by the necessity of closing the laboratory from September to May of each year.

In 1932, at the invitation of the Connecticut Shellfisheries Commission, the laboratory was moved to a small shack on the state dock and full-time investigations were initiated. At that time arrangements were completed with Yale University for laboratory space in which to conduct experiments of a more elaborate and technical nature. In 1937 the Connecticut State Legislature passed a bill that deeded a portion of the land at Milford to the former Bureau of Fisheries. Construction of a new permanent laboratory was made possible through the allocation of P. W. A. funds by Secretary of the Interior Ickes, in his capacity as Public Works Administrator.

The Milford Station is the center from which oystermen obtain data regarding the condition of oysters on various beds, the expected time of setting and the presence of starfish and other enemies, as well as information which may be useful to the oyster farmer. Through the facilities of the new laboratory scientific knowledge necessary for the conservation and management of the oyster resources will be more readily obtainable.

The dedication of the Milford Laboratory was held in conjunction with the joint annual convention of the Oyster Growers and Dealers Association of North America, the National Shellfisheries Association and the Oyster Institute of North America. Sessions were held at New Haven, Conn., on July 31 and August 2, and at Milford on August 1. W. C. Henderson, assistant director of the Fish and Wildlife Service, delivered a message from Secretary Ickes. Drs. Paul S. Galtsoff, H. F. Prytherch, Victor L. Loosanoff and Messrs. James B. Engle and R. O. Smith of the shellfisheries investigations staff of the Division of Scientific Inquiry, and J. F. Puncochar, of the technological staff of the Division of Fishery Industries, presented reports on their investigations at the various sessions.

SYMPOSIUM ON HYDROBIOLOGY AT THE UNIVERSITY OF WISCONSIN

A SYMPOSIUM on hydrobiology will be held at the University of Wisconsin on September 5, 6 and 7, funds for which have been provided by the Wisconsin Alumni Research Foundation.

Forty-two scientific papers discussing the history, geology, physics, chemistry, bacteriology, botany and zoology of bodies of water in all parts of the world are listed in the program. Both social and economic aspects of inland lakes and streams will be given considerable attention at the symposium. The conservation of water in lakes and streams and how to use these bodies of water to the best advantage for fish culture and recreation will be discussed. Several papers on Wisconsin lake studies will be given, since research work on the state's lakes and streams has been carried on for a number of years by the Wisconsin Geological and Natural History survey.

Among the fifty-five investigators expected to be present there are two scientific men from abroad: Kaare M. Ström, Norwegian limnologist from the Geological Museum at Oslo, who will present a paper on "The Sediments of Norwegian Lakes," and Dr. S. F. Snieszko, formerly professor of bacteriology at the University of Krakow, Poland, who will read a paper on "Pond Fish Farming in Poland." Dr. Snieszko is now at the University of Maine.

A dinner in honor of the eighty-ninth birthday of Dr. E. A. Birge, president emeritus of the University of Wisconsin, at which Dr. C. A. Dykstra, president of the university, will preside, will be given on September 5.

THE OPTICAL SOCIETY OF AMERICA

THE twenty-fifth annual meeting of the Optical Society of America will be held in Rochester, N. Y., with headquarters at the Hotel Sagamore, on October 3, 4 and 5. It is pointed out in the official announcement that the selection of Rochester for the twenty-fifth annual meeting is a natural one, in view of the importance of the city in the optical industry and of the part which Rochester members have played in the organization and development of the society. Special arrangements are being made to commemorate the twenty-fifth annual meeting, and a local committee, appointed by the Rochester Section, is active in plans to make the meeting successful.

The program as tentatively arranged is as follows:

THURSDAY, OCTOBER 3

Morning—Contributed papers.

Afternoon—Reserved for visits to industrial plants in Rochester.

Evening—Lecture by Edwin H. Land illustrated by experiments and by exhibits of Polaroid and some of its applications in the field of photography.

FRIDAY, OCTOBER 4

Morning—Symposium of invited papers. These are intended to comprise a review of the development of optics with emphasis on recent significant advances in the field, thus endeavoring to present both the historical and contemporary aspects.

Afternoon—Reserved for visits to industrial plants in Rochester.

Evening—Complimentary dinner at the Oak Hill Country Club, at which members and their wives will be the guests of the Bausch and Lomb Optical Company. The dinner, at which informal dress will be in order, will be featured by a recognition of the active Charter Members of the Society and the award of the first Adolph Lomb Medal.

SATURDAY, OCTOBER 5

Morning—Contributed papers.

Afternoon—Reserved for additional contributed papers as required.

Members desiring to read papers at the meeting are requested to send abstracts to Arthur C. Hardy, Secretary, Optical Society of America, Massachusetts Institute of Technology, Cambridge, Massachusetts. They should be in his hands not later than September 11. The chairman of the program committee is A. W. Kenney, of the E. I. du Pont de Nemours and Company. Mr. Hardy has been filling, until the next annual meeting, the vacancy created by the resignation as secretary of L. B. Tuckerman.

SCIENTIFIC NOTES AND NEWS

DR. THOMAS BARBOUR, director of the Museum of Comparative Zoology, Harvard University, has been elected a foreign member of the Linnean Society of London.

THE retirement is announced of Dr. Charles Albert Browne, supervisor of chemical research in the Bureau of Chemistry and Soils of the U. S. Department of Agriculture. Dr. Browne has been connected with the Department of Agriculture since 1906.

G. G. BROWN, professor of chemical engineering at the University of Michigan, was recently the recipient of the Hanlon Award of the Natural Gasoline Association of America for "outstanding contributions in the field of natural gasoline."

THE title of dean emeritus has been conferred on Dr. Langley Porter, of the Medical School of the University of California. He had been associated with the school since 1918.

COLONEL HAROLD W. JONES, librarian of the Army Medical Library, Washington, D. C., was reelected president of the Medical Library Association at its annual meeting in Portland, Ore., which was held on June 25, 26 and 27. Dr. Robert E. Schlueter, St. Louis, was elected vice-president and Miss Anna C. Holt, Harvard Medical School Library, Boston, was reelected secretary. The convention in 1941 will be held at the Medical School of the University of Michigan.

THE following officers for the year 1940–41 were elected at the annual meeting of the Royal Society of Queensland: *President,* Dr. F. W. Whitehouse; *Vice-presidents,* H. A. Longman and Professor H. R. Seddon.

DR. C. E. MCCLUNG, who recently retired as director of the biological laboratories at the University of Pennsylvania, has been appointed visiting professor of biology at the University of Illinois.

Dr. Henry J. Masson, professor of chemical engineering and director of the Graduate Division of the College of Engineering of New York University, a member of the faculty for twenty-three years, has been appointed acting director of the evening division of the College of Engineering. He succeeds Professor Sampson K. Barrett, who will devote his full time to teaching.

Dr. Willard L. Valentine, associate professor of psychology at the Ohio State University, has been appointed chairman of the department of psychology at Northwestern University.

Dr. Rogers D. Rusk, since 1928 associate professor of physics at Mount Holyoke College, has been appointed chairman of the department to succeed Dr. Elizabeth R. Laird, who retired in June.

Dr. Bradley T. Scheer, research assistant in the division of biochemistry and physiology at the Scripps Institution of Oceanography of the University of California at La Jolla, has been appointed instructor in zoology and physiology at West Virginia University.

Dr. T. G. H. Jones, lecturer in chemistry at the University of Queensland, has been appointed professor of chemistry in succession to the late Professor L. S. Bagster.

Dr. Jasper L. Stuckey, who resigned as state geologist of North Carolina in 1926 to become professor of geology in the State College at Raleigh, has returned to the survey to succeed H. J. Bryson, who resigned in the spring to take a position with a mining concern. Dr. Stuckey, who is head of the department of geology at the State College, will continue as a member of the faculty, devoting himself on a part-time basis to the administrative functions of state geologist. T. G. Murdock, for a number of years a mining engineer in Chile, Peru, and more recently in Cuba, who has been appointed assistant state geologist, took up his work on August 1.

Dr. Robert Jackson Noble, chief biologist of the Department of Agriculture of New South Wales, has been appointed under secretary for agriculture in succession to G. D. Ross, who retired recently because of ill health.

Dr. W. J. Gertsch, associate curator of spiders of the American Museum of Natural History, has returned from an expedition to Utah and Arizona bringing with him a collection of 5,000 spiders, including black widow spiders and tarantulas. Many of the specimens brought back were found at altitudes of 8,000 to 10,000 feet.

Dr. Mary Swartz Rose, professor of nutrition at Teachers College, Columbia University, has leave of absence until July 1, 1941, when she will retire.

Dr. Francis Scott Smyth, of the department of pediatrics of the University of California, will spend six months at the Medical School of the University of Buenos Aires working in the department of physiology with Dr. B. A. Houssay, professor of physiology.

Dr. Hernán Aguilar, associate professor of medicine at Buenos Aires, has sailed for the United States to work on thoracic surgery in the Medical School of Washington University, St. Louis.

Dr. Sharat K. Roy, curator of geology of the Field Museum, Chicago, who is conducting an expedition to various localities in Wyoming, Colorado and South Dakota and also to various eastern states to collect specimens relating to structural and dynamic geology, left Chicago on August 16. He expects to be absent for about ten weeks.

León Grodsinsky, of the Division of Phytopathology of the Ministry of Agriculture, Buenos Aires, sailed on August 9 for home. He had spent a year in phytopathological and mycological study in the United States. He was a delegate to the eighth American Scientific Congress held in Washington, D. C., from May 10 to 21.

Owing to the war, the meeting of the Australian and New Zealand Association for the Advancement of Science has been postponed indefinitely.

The Second National Medical Congress in Peru is to be held this month in Arequipa under the auspices of the Peruvian Government in connection with the four hundredth anniversary of the founding of the city. There will be sections for medicine, surgery, hygiene and social medicine.

The Allegheny Section of the Society for the Promotion of Engineering Education will hold its sixth annual meeting at the Carnegie Institute of Technology, Pittsburgh, on October 25 and 26. The subject of the meeting will be "The Coordination of Engineering Curricula." The address of welcome will be made by Dr. Robert E. Doherty, president of the institute. The Engineers' Council for Professional Development will meet in Pittsburgh on October 24.

A conference on Soil Mechanics and Its Applications will be held at Purdue University, West Lafayette, Ind., from September 2 to 6, under the auspices of the Committee on Foundations and Soil Mechanics of the Civil Engineering Division of the Society for the Promotion of Engineering Education and the School of Civil Engineering and department of engineering extension of Purdue University.

THE *Journal* of the American Medical Association states that Dr. David Riesman, professor of the history of medicine, who died on June 3, bequeathed his brain to the Wistar Institute of Anatomy for research purposes. He made a bequest of $1,000 to the College of Physicians of Philadelphia; of $500 to the Philadelphia County Medical Society and of $2,000 to the medical board of the Philadelphia General Hospital "to encourage research on the part of the staff."

A NEW bird exhibit, known as the Snow Mountains-New Guinea Group, in the Whitney Memorial Hall of the American Museum of Natural History was dedicated by Mrs. Harry Payne Whitney on August 20. The group, which is a replica of bird life 11,000 feet up in the little-known Snow Mountains of Netherland New Guinea, was presented to the Museum by Richard Archbold, and was collected by Dr. A. L. Rand, of the American Museum staff, during the 1938–39 Archbold-New Guinea Expedition of the museum. The principal speaker at the ceremony was the Honorable J. S. Schurman, Consul General of the Netherlands.

ACCORDING to the London *Times* the department of zoology of the British Museum has received from Admiral Sir Sidney Bailey a series of mounted heads of North American ungulates, including a very fine moose and some exceptionally good wapiti and caribou. The collection also contains a head of a Rocky Mountain goat. Another gift to the same department is a series of 10 skulls with horns of African antelopes from the Dinder River District of the Sudan, presented by Mr. T. W. H. Dore. This collection includes some skulls of Soemmerring's gazelle and of the Sudan race of the roan antelope. The department of geology has acquired from the committee of the Royal Literary and Scientific Institution, Bath, a collection of 99 invertebrate fossils from the mesozoic of Australia, including a number of type and figured specimens.

A WESTINGHOUSE Electric and Manufacturing Company exhibit at the Golden Gate Exposition, San Francisco, is a model of the giant 200-inch Mount Palomar telescope by means of a one-tenth size operating scale model constructed at the cost of $25,000. The model is owned by the California Institute of Technology, which has used it for more than a year for actual astronomical observations. Although it was built primarily to illustrate the construction of the Palomar telescope, the 20-inch mirror makes it valuable for practical use. Throughout the construction, technicians of the company collaborated with experts from the California Institute and the Mount Wilson Observatory. Reproduced in the model is the horseshoe bearing, which in the big telescope makes it possible to swing the shaft of the instrument with 1-165,000th of a horsepower. The original bearing itself weighs 400,000 pounds and is 46 feet in diameter.

ACCORDING to *The Collecting Net*, a new instrument, the Continuous Plankton Recorder, has been received by the Oceanographic Institution at Woods Hole, which will have the recorder on loan from Professor A. C. Hardy, of University College, Hull, England, for the duration of the war. The instrument will be used to record the density of living matter in the ocean, and has the advantage over other forms of collecting apparatus in that it does not have to be periodically removed from the water. It can be towed by a ship and will record the fluctuation in density of living matter along the course. Shaped like a torpedo, the recorder contains a spool of gauze which unwinds as the plankton is caught at the rate of about an inch for every mile that the ship travels. About twenty of these recorders are now in existence, and the two at the Oceanographic Institution, which will be used by the *Atlantis*, are the only ones outside of England.

THE London *Times* reports that two films concerned with problems of British agriculture recently were shown privately in London to a specially invited audience which included several members of Parliament. The films were presented by John Grierson, who spoke of the contribution that films could make towards bridging the gap in understanding between townsmen and countrymen, and in making known to the farmers the important work that agricultural research stations are doing. "Speed the Plough" and "Protection of Fruit" were, Mr. Grierson said, the first of many films which might be made; production had just begun on a film describing the grass breeding experiments being carried out by Professor Sir Reginald George Stapledon at the University of Aberystwyth. "Speed the Plough," which was made under the supervision of Professor Scott Watson, is designed to show the new mechanical and scientific methods that are being adopted by farmers. The film on the "Protection of Fruit" was made in collaboration with agricultural research stations in Great Britain and in Holland and Palestine. It has been specifically made for showing to audiences of farmers.

THE *Journal* of the American Medical Association states that the Kaiser Wilhelm Society for Scientific Research has been increased by the addition of a new institute of biophysics, constructed in Frankfort on the Main with the support of the city and the cooperation of the university. The building contains twenty research laboratories. There is here the first laboratory for the diagnosis of radium-intoxicated persons, that is, occupational diseases like those of miners and employees of radium factories. The principal tasks of the institute are the investigation of the biophysical problems of the effects of roentgen and radium rays on the tissues, the problems of the medical and the technical use of light, the effects of electric waves and of radioactive substances and the study of idioradiation of living organisms, especially of the hypothetical rays of cell division. The new institute will be under the direction of Professor Rajewski.

DISCUSSION

A STANDARDIZATION OF OSMOTIC PRESSURE AS A TERM

The vast amount of confusion which arises from certain physiological terms makes it advisable to bring about a standardization of such terms so that each term will convey a definite and clear concept. Osmotic pressure is a term which most of all needs standardization. At national botanical meetings in discussions involving osmotic relations it is apparent that no two of the botanists have quite the same idea or definition for osmotic pressure. Authors of botanical texts also show a diversity of opinion on the subject. Apparently, some authors either are undecided about a definition or regard the usual definition as unsatisfactory because they present no definition for osmotic pressure.

The definition of osmotic pressure which is generally accepted is that it is or is equal to the maximum hydrostatic pressure exerted by a solution when it is in equilibrium with pure water at the same temperature. This definition is poor and confusing because it either infers erroneously that osmotic pressure is the result and not the cause of osmosis or merely evaluates the pressure in terms of another variable without explaining or describing the nature and the cause of osmotic pressure. Shull[1] in explaining an example which he cited states that "the actual osmotic pressure here is the pressure of the water molecules passing through the bladder membrane." This idea of Shull is a splendid one and is the one which should be universally adopted, because it describes osmotic pressure as a dynamic and functional force, and not as an end result, which it certainly is not.

Since the author has given this subject considerable thought and has discussed it at great length with Dr. Lyons, of Dartmouth University, and has discussed it somewhat with several other plant physiologists, he wishes to propose the following standardization for osmotic pressure. Please bear in mind that the proposed standardization is merely an expansion of Dr. Shull's sound and logical idea.

> Water molecules diffusing through a membrane exert a diffusion pressure. Since this special type of diffusion is called osmosis, the diffusion pressure of the water molecules tending to diffuse through the membrane can logically be referred to as *osmotic pressure*. It should be understood that osmotic pressure is not the result of osmosis but that it is the cause of osmosis, and that osmotic pressure is both the diffusion pressure exerted inwardly by water diffusing into the cell and the diffusion pressure exerted outwardly by water diffusing out of the cell.
>
> The osmotic pressure of the water in the vacuole of a plant cell is increased by turgor pressure and decreased by the solute concentration of the cell sap. The water in the plant vacuoles at a given turgor pressure has a maximum osmotic pressure when there are no solutes present. With increased concentrations of solutes in the cell sap, the osmotic pressure of its water is proportionally reduced. To say that the osmotic pressure of the cell sap of a given cell is 1.5 M means that the diffusion pressure of the water in the cell sap is the same as the diffusion pressure of the water in a 1.5 M aqueous solution of cane sugar. To say that the osmotic pressure of the cell sap of a given cell is 4.2 atmospheres means that the diffusion pressure of the water in the cell sap is 4.2 atmospheres less than that of pure water at the same temperature and external pressure. Each gram molecular weight of cane sugar or of any non-electrolyte dissolved in enough water to produce a total of one liter of solution reduces the diffusion pressure of the water molecules 22.4 atmospheres at standard conditions (0° C. and 760 mm. barometric pressure).
>
> The rate of osmosis into a cell is directly proportional to the difference between the osmotic pressure of the water surrounding the cell and the osmotic pressure of the water inside the cell.
>
> Water diffuses osmotically from the cell with the greater osmotic pressure to the adjacent cell with the less osmotic pressure. For example water diffuses from the cell with an osmotic pressure of .2 M to a cell with an osmotic pressure of .4 M. Distilled water which has an osmotic pressure of *zero molar* will diffuse into a cell with an osmotic pressure of .2 M. It must be remembered that the greater the solute concentration the less is the osmotic pressure of the solvent (water), because solute molecules decrease the activity of the solvent molecules.

If one defines osmotic pressure as the diffusion pressure of solvent (water) molecules tending to diffuse through a membrane, there is no need for the terms "diffusion pressure deficit" and "suction tension." These latter terms are not desirable. The term "diffusion pressure deficit" erroneously conveys the idea to many that a cell with a diffusion pressure deficit is in an abnormal state. The term "suction tension" indicates that a cell takes up water by a sucking action which in reality does not exist.

The above standardization for osmotic pressure as a term is advisable, therefore, (1) because it is simple, sound and logical, (2) because it does not necessitate the use of the undesirable terms "diffusion pressure deficit" and "suction tension," and (3) because there is no need for the term "net osmotic pressure."

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[1] Charles A. Shull, "A Textbook of Botany Revised." Vol. II. "Physiology," p. 16. Cincinnati: American Book Company, 1930. (Coulter, Barnes, and Cowles.)

H. C. EYSTER

UNIVERSITY OF SOUTH DAKOTA

STRAIN SUSCEPTIBILITY TO THE EUROPEAN CORN-BORER AND THE CORN-LEAF APHID IN MAIZE

THE European corn-borer (*Pyrausta nubilalis* Hubn.), a chewing insect, and the corn-leaf aphid (*Aphis maidis* Fitch), a sucking insect, are both serious pests of *Zea mays* L. Differential susceptibility to the corn-borer among corn strains has been recognized for several years. The authors have recently found: (1) a differential susceptibility among corn strains to the aphid and (2) significant correlations in the degree of strain susceptibility to these two widely different pests.

Among corn hybrids grown in northwestern Ohio, significant correlation coefficients of 0.570 and 0.844 were found in different seasons between expected aphid infestation based on aphid susceptibility ratings of the parent inbred lines and estimates of actual corn-borer infestations. Estimates of aphid abundance were based on actual counts of infested plants. Estimates of corn-borer abundance were based both on counts of infested plants and on stalk breakage associated with corn-borer damage. These correlation values are as high as have usually been found between corn-borer infestation counts on the same corn strains in different seasons. Correlations between corn-borer and aphid infestations on the same plots may, however, be very low because of competition between the insect species.

The relation has one immediate practical application. For corn-growing areas where the corn-borer is a serious pest, the differential strain susceptibility to corn-borer infestation provides a basis of major importance in classifying breeding material. The chief difficulty in measuring strain susceptibily has been burdensome techniques. In general, the choice lay between (1) adequate sampling of stalks with either natural or manual infestation and (2) feeding etiolated leaves of different strains to young larvae in the laboratory. Manual infestation reduces the number of plants needed for dissection but adds the requirement of rearing moths and applying eggs; it adds also an uncertainty of simulating natural conditions. Further, stalk dissection readings are subject to a large error unless properly timed with reference to the usually different maturity of the strains under study. Laboratory feeding also requires the rearing of moths and handling of eggs and larvae in addition to providing a constantly fresh supply of food.

Counts of aphid colonies, on the other hand, can be made rapidly. The evidence indicates that the degree of aphid infestation may be used as an index to the degree of strain susceptibility to the corn-borer, at least for preliminary classifications of corn-breeding material.

L. L. HUBER

G. H. STRINGFIELD[1]

OHIO AGRICULTURAL EXPERIMENT STATION,
WOOSTER

AN EXPERIENCE OF GENERAL ANESTHESIA

HAVING been occupied for some time with a disquisition on "Biology and Substance" I have had an experience in the last two days that furnished me facts and reflections on the subject that interests me a good deal and it has occurred to me might be of some interest to other people.

The discovery had recently been made by myself and my dentist that I had two teeth that were worse than useless, with the consequent decision that they had better be extracted. Passing over details in preparation for this I merely mention that the decision was that there should be general instead of local anesthesia —heretofore never experienced by me. Early in the morning I found the anesthetist with some sort of a contrivance beside my head with the instruction that I breathe perfectly naturally. My only response so far as I remember was the foolish question as to whether this was "N O" or "N O 2," to which she replied "N O."

Although I was naturally not holding the stop watch, as near as I could judge it could not have been many minutes at most before I was completely gone so far as my consciousness was concerned. When I came to my senses forty-five minutes later, as I was told, I was aware of some soreness in my mouth and not much later I was wide awake and restored to my regular bed in the hospital. What particularly interests me is the problem of what, during the period of nonexistence so far as my consciousness was concerned, that substance, "N O," was doing to me.

I note, first of all perhaps, that from my little knowledge of chemistry and biochemistry I know that nitrogen and oxygen were playing important parts in my existence up to the time my existence disappeared. Their action on me must, however, have been very different when the two were combined to make "N O" than when either was thus uncombined. How is such a thing possible? How was it that the combination of those two chemical elements could produce such a striking effect as compared with what either of them could do alone or in other combinations; and the gist of my inquiry is as to the latent qualities or properties which each separate chemical substance must have that can be actualized in no other way than by their coming together to make the compound substance put me out of conscious existence. No amount of chemical examination in the laboratory, so far as I know, would indicate that the two would unite and make a substance that would have such a remarkable effect.

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[1] The Departments of Entomology and Agronomy, Ohio Agricultural Experiment Station, and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, cooperating.

I raise the question of whether this striking example of chemical transformation is more or less typical of all chemical transformation. Is there anything about the phenomenon that we can say intelligently, other than that chemical transformation in general is a process of bringing into actuality the potential qualities that the elements have, which can be discovered in no other way than just that of their acting on one another; and that when they have made a compound substance, the action of that substance can be discovered in no other way than by trying it on a living being more or less like myself?

I wonder if this sort of thing which is now common knowledge to us moderns, does not throw some light on the seemingly endless speculation of the philosophers and theologians, not to say some expert scientists, with reference to what the idea of substance really amounts to.

It looks to me as though the idea of potentiality, of which Aristotle made much as to that particular meaning of the Greek *dunamis,* has been overly neglected in the natural knowledge of the modern era.

Wm. E. Ritter

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THE CONQUEST OF LEPROSY

In 1927 my wife and I visited Dr. Douglas Collier and his wife, Dr. Mary Collier, at their mission station at Nan, Siam. We also went to Chiengmai, where Dr. J. W. McKean was in charge of the admirable institution for the care of lepers. These medical missionaries worked under the auspices of the Presbyterian Board, and we felt that their work was of the utmost importance to the country, and a credit to their American supporters.

The years have gone by, Dr. McKean has retired, and now lives in California; Dr. Collier has moved to Chiengmai, and taken up the work with the lepers. All this might not call for special comment were it not that at last after long years of investigation, it appears probable that leprosy may be actually conquered. The experimental work at Chiengmai, in its present form, was initiated by Dr. M. J. Oberdoerffer, a young German who had worked in Africa under the British Empire Leprosy Relief Association. It appeared that the eating of colocasia predisposed to the development of leprosy, apparently due to a toxic substance also found in partly decomposed fish. Using this method, it was found possible to cause monkeys to acquire leprosy, something which it had seemed impossible to do before. The conclusion was reached that injury to the adrenal glands was the more immediate cause of trouble, and short-wave radiation was used to stimulate these glands, with satisfactory results. However, it was suggested that possibly the use of diphtheria antitoxin might be beneficial, as in diphtheria a toxin is liberated which damages the adrenal glands. In diphtheria, antibodies are formed, but this seems not to be the case in leprosy. When the work had reached this promising stage, Dr. Oberdoerffer, on account of poor health, felt obliged to leave Siam. Dr. Collier continued the work, now using toxoid instead of the old antitoxin. The results have been extraordinary, and Dr. Collier states:

> In the use of toxoid and antitoxin we have a treatment which far exceeds any method yet known. Results are obtained in a few weeks, which formerly were seen only after months or years of treatment. While the early cases are less spectacular in response, all types seem to be benefited.

It is reasonably hoped to immunize the children and associates of lepers, and so in time eradicate the disease. All these matters are set forth in a paper just received, published in the *Journal of the Thailand Research Society* (Bangkok), February, 1940.

T. D. A. Cockerell

University of Colorado

SCIENTIFIC BOOKS

THE KOSHER CODE

The Kosher Code of the Orthodox Jew. Being a literal translation of that portion of the sixteenth-century codification of the Babylonian Talmud which describes such deficiencies as render animals unfit for food (Hilkot Ṭerefot, Shulḥan ʻAruk); to which is appended a discussion of Talmudic anatomy in the light of the science of its day and of the present time. By S. I. Levin, senior rabbi of Minneapolis, and Edward A. Boyden, professor of anatomy, University of Minnesota. xx + 243 pp. Minneapolis: University of Minnesota Press. 1940. $4.50.

The anatomist and embryologist must visit, if not frequent, the slaughter-house. The late Professor Minot remarked, in his quiet way, "It is hell," as he sent the reviewer there. Dr. Boyden's errand, fifteen years ago, was to find how often partly divided and supernumerary gall bladders occur in calves and sheep

—2,500 of each. In the abattoir "kosher cutters" from the local synagogues were on hand, inspecting viscera and mysteriously accepting as kosher or kasher the carcasses ritually fit, but occasionally rejecting one as terefah or terephah ("torn of beasts"). They told Dr. Boyden that such anomalies as he sought "were already described in the Shulhan 'Aruk"—the code of Jewish law under which they served. This code consists of text written by a sixteenth-century Palestinian rabbi of Spanish origin (published in Venice, 1564), with notes inserted in the text by a Polish rabbi, also of the sixteenth century (published in Cracow, 1571), and several layers of commentaries surrounding the text, added in the seventeenth, eighteenth and nineteenth centuries. A formidable sample page of the Shulhan 'Aruk, Vilna ed., 1873, serves as frontispiece. Undismayed, and believing that the critical inspection of myriads of animals for nearly two thousand years must have yielded important anatomical observations, Dr. Boyden made light of the labor. The French version of the code by Pavly and Neviasky (1898) was found to be neither literal nor anatomically dependable. In no other modern language were the terefah sections available.

It happened that Professor George F. Moore, theologian, sometimes accounted the most learned member of the Harvard faculty, had been puzzled by the Scriptural and Talmudic references to a "redundance upon (or of) the liver," to be burnt upon the altar. Its various interpretations as omentum (caul), diaphragm or "finger" of the liver caused him to make personal inspection. All that he wrote of this λοβός in an essay (1906) with title in Hebrew, Greek, Aramaic, Arabic and Syriac appears correct, save that he identified it with "the caudate lobe" rather than "the caudate process of the caudate lobe"—a nomenclatorial error which he humbly confessed. At Dr. Boyden's request, Professor Moore called in a rabbinical scholar of Boston who reviewed for him the entire Talmudic and later Hebrew descriptions of the gall bladder, which was the stimulus for the larger project. "Eventually," writes Dr. Boyden, "it became my good fortune to enlist the aid of the senior orthodox rabbi of Minneapolis"—Rabbi S. I. Levin. Rabbi Levin undertook to translate all the 32 sections of the treatise on Terefot, with summaries of such portions of the extensive later commentaries as seemed appropriate, making the book an authentic English version of the regulations now in force, sound from the viewpoint of orthodox Jewry. With diverse but non-conflicting objectives—namely, the production of an orthodox manual and the presentation of everything of anatomical interest in this extensive literature—the joint authors collaborated until their difficult and valuable work was happily concluded by the publication of the rather small volume before us.

"The reason why slaughtering must be done at the neck and the knife must be inspected," writes Rabbi Levin in the Introduction, "is that the animal or fowl should not be made to suffer: the Lord has permitted us to use the animal or fowl, but not to cause it to suffer needlessly." Emphatically the Pentateuch enjoins, "Ye shall eat no manner of blood, whether it be of fowl or of beast—for the life of the flesh is in the blood: thou shalt pour it upon the earth as water." Accordingly, the throat must be cut, and "lost in tradition" is the source of the further precept regarding the gullet and windpipe, that "most of one of them in a fowl, and most of both of them in cattle, should be severed at the time of slaughtering."

This method of slaughter, which differs from the classical Greek and Roman in requiring a sharp smooth knife without a nick and in not allowing cattle to be felled with an axe, has been described by Dr. Isaak Dembo, of St. Petersburg, as "ideal," if that word could be applied to the killing of an animal. The cut "is entirely painless," he finds, and consciousness is lost within "three to five seconds." Dr. Dembo's approval of "The Jewish method of slaughter compared with other methods from the humanitarian, hygienic, and economic points of view" was published, in authorized translation, in London, 1894. In prefatory letters, Virchow hopes that the researches will "at last bring comfort to distressed minds," and Professor Preyer finds the Jewish method "the safest and most expeditious." Ten years later, in 1904, the British Government appointed a distinguished committee, Mr. Arthur H. Lee, Civil Lord of the Admiralty, *chairman*, "to ascertain the most humane and practicable methods of slaughtering animals for human food." Its report (Parliamentary Papers, Cd. 2150) recommends that "all animals, without exception, must be stunned, or otherwise rendered unconscious, before blood is drawn." In collaboration with two such eminent physiologists as Sir Michael Foster and Professor Starling, the committee was forced to conclude that "the Jewish system fails in the primary requirements of rapidity, freedom from unnecessary pain, and instantaneous loss of sensibility, and that it compares very unfavourably with the methods of stunning." In view of these diverse verdicts and with no comparable deliverance by American physiologists, the reviewers can perhaps agree that the slaughter-house is not yet a place of twilight sleep: improvement may not be impossible.

The Kosher Code is an intricate system of regulations and practical measures for determining whether or not an animal is healthy and fit for food. The origin of these laws is a brief statement in the Pentateuch that an animal torn by a beast of prey is not to be eaten. Out of this, these laws developed along the same lines as all the other oral laws of Judaism.

There must have been a nucleus of supplementary oral traditions existing by the side of the written law from its very inception. In course of time, with the appearance in Judaism of general principles of interpretation of the written law, the theory was evolved that the written statement of the Mosaic law should not be taken in a strict and narrow literal sense as a prohibition to eat the meat of an animal that has been actually torn by a beast of prey, but should rather be understood in a more general way as prohibiting the meat of any animal that has been mortally wounded or ravaged by some disease. Since the marauder *punctures* with his claws, the Mosaic law was interpreted as prohibiting all similar perforations, whether by needle, thorn or disease; and difficult decisions must be made when the apertures are closed by adhesions or scar tissue. The neat round holes in the wall of the aorta are orifices of intercostal branches and can be disregarded. "If the heart is perforated, and the hole does not reach the cavity, the animal is kasher if the perforation is due to disease; but if it is made by a thorn or needle, it is terefah."

Predatory animals tear out organs; and missing parts, whether from disease or congenital absence, may disqualify. So also the anomalous doubling of certain organs, on the principle that "every addition is considered an absence"; but always there are exceptions. In kosher animals the spleen or kidneys may be absent; or two spleens or three kidneys may be present. Some rulings, perhaps, depend on hypothetical cases. The finest description of normal and diseased bovine lungs in antiquity is prominently presented. The lungs, indeed, receive special attention: they should be inflated in searching for adhesions and solidifications, but with more fear of punctures than of tubercles. Without discriminating clearly between small and large intestines, Meckel's diverticulum is evidently recorded. Aristotle's *echinus* receives its current name *omasum*.

Thus the free interpretation of the Mosaic law has led to the study and observation of the animal body, its structure and its functions; and religion, here as elsewhere, thus became indirectly the incentive of scientific observations and generalizations. But the scientific interest was subservient to the religious interest and its scope was limited by the special religious needs. In the literature produced in Judaism between the second and fifth centuries after the Christian era, *i.e.*, in the Mishnah and Talmud, the body of accumulated scientific observations and notions, together with their practical application, was committed to writing, and from that time on it remained substantially unchanged.

The medical conceptions in this literature, as has been observed by Professor Boyden, approach those of the Hippocratic school, though, it must be added, there is no evidence that they have been formed under the direct influence of Greek medical literature. They undoubtedly represent a native development, under the exigencies of religion, of certain rudimentary elements inherited from the ancient Semitic world and perhaps also of certain elements absorbed from the later Hellenistic environment.

But in the meantime the science of the structure and functions of the animal body grew apace independently of religion, and the results of the findings of this independent science are not always in agreement with the traditional religious science. To the student of religious institutions the question may, therefore, occur whether it would be possible in Judaism to replace the old traditional science by the new science to be used in the service of its laws with regard to *terefah*. The question was actually raised in the twelfth century by Maimonides, who, besides being a great codifier of Jewish law, was also a great philosopher and scientist, and was especially acquainted with the writings of Galen and the Arabic medical literature. It is interesting to note that, while in the purely speculative elements of religion Maimonides did not hesitate to interpret the most fundamental beliefs of traditional Judaism in terms of what he believed to be the true scientific principles of philosophy, in its practical observances relating to the laws of *terefah* he openly expressed himself in opposition to replacing the old traditional regulations by the new findings of science. In Judaism, as in any other religion, there is always a greater plasticity in abstract ideas than in concrete observances and institutions. The code under consideration, therefore, though written in the sixteenth century, represents the early native Jewish medicine and does not reflect the Greek and Arabic medical knowledge which by the time of its writing had already been accessible in Hebrew translations, as well as in original Hebrew works, for about three centuries.

It would be, however, wrong to assume that the observance of the orthodox Jewish laws of *terefah* would ever come into actual conflict with modern regulations concerning the same matters. With all its insistence upon the traditional methods of determining the health of animals, orthodox Judaism can have no objection, on purely religious grounds, to have those methods supplemented by modern scientific methods, whenever the former methods prove to be scientifically inadequate and ineffective.

Much more might be said. A code of laws is seldom entertaining literature. We have here no masterpiece of prose, but a source-book of extraordinary interest. We commend it to the consideration of the Book of the Decade Club.

Harry A. Wolfson
Frederic T. Lewis

Harvard University

REPORTS

RESEARCH WORK ON CHEMOTHERAPY

AT the meeting of the Division of Chemistry and Chemical Technology of the National Research Council in Washington, D. C., in April, 1939, the opinion was expressed that research work should be stimulated in the field of quinine substitutes and synthetic antimalarials.

While quinine, plasmoquine, atebrine and a few other drugs have been useful, there is in the judgment of the medical profession, great need for something better. The present remedies leave much to be desired from a therapeutic point of view, and the price is higher than many can afford to pay. Further, so far as quinine itself is concerned, the world is practically dependent for its supply on Java and the Kina Bureau (its selling agent) and might be cut off from this supply or perhaps compelled to pay exorbitant prices if Java should be seized by some other nation. The trend is therefore toward synthetics as the direction which holds out the best promise of new and useful antimalarials.

Contrary to popular belief, malaria is still one of humanity's major scourges. India, with a population of some 320,000,000, has a yearly average of from 70 to 80 million sufferers, and President Fosdick, of the Rockefeller Foundation, in his recent annual report, has called attention to the threatening situation in South America. In certain tropical countries the incidence of this disease is 100 per cent. Throughout the world it is stated to be the direct cause of approximately a million deaths annually.

Dr. Herbert R. Moody, chairman of the division, was duly empowered to appoint a temporary committee to survey the field of malaria and antimalarials and to report back to the division whether or not it would be advisable to designate a regular standing committee of the division to study, in cooperation with the division of medical sciences, the whole problem of the chemistry and synthesis of antimalarials.

The temporary committee appointed by Dr. Moody, from the division of chemistry and chemical technology, consisted of Dr. Leonard H. Cretcher, assistant director of the Mellon Institute of Industrial Research, Pittsburgh; Dr. Lyndon F. Small, head chemist of the National Institute of Health, U. S. Public Health Service, Washington, D. C., and Marston T. Bogert, emeritus professor of organic chemistry in residence, Columbia University, New York, as chairman.

Later, on the nomination of Dr. Esmond R. Long, chairman of the National Research Council division of medical sciences, the following members for that division were added to the temporary committee: Dr. Lowell T. Coggeshall, International Health Division, Rockefeller Foundation, New York, and Dr. Torald H. Sollmann, dean, Western Reserve University School of Medicine, Cleveland.

The completed committee thus consisted of the following chemical and medical representatives: Lowell T. Coggeshall, Leonard H. Cretcher, Lyndon F. Small, Torald H. Sollmann and Marston T. Bogert, chairman.

As a result of this preliminary survey, the temporary committee reported unanimously that, in its judgment, a regular standing committee of the division of chemistry and chemical technology should be constituted by the National Research Council, to concern itself not solely with antimalarials, but whose function should be chemistry in the service of medicine and its title Committee on Chemotherapy, with antimalarials as its first assignment.

This broadening of the field to be covered by the committee will not reduce in any way its usefulness in an attack on the malaria problem but will permit it to offer its services in attempts to combat other diseases as well, particularly in those cases in which acute emergencies may arise and our help be welcome. Even in the investigation of antimalarials, other diseases are concerned, for example, the possible use of cinchona alkaloids or their derivatives in the treatment of pneumonia, a problem which has been under investigation by Dr. L. H. Cretcher at the Mellon Institute for a number of years.

At the meeting of the division of chemistry and chemical technology, National Research Council, November 18, 1939, in Washington, D. C., the report of the temporary committee was presented and adopted and the committee was discharged. The division then recommended that the same personnel be appointed as one of its regular standing committees, to be known as its Committee on Chemotherapy. This recommendation of the division was subsequently approved by the National Research Council, and Surgeon General Thomas Parran, Jr., of the U. S. Public Health Service, gave his prompt consent to the service of Dr. Small on the committee.

The Academy of Tropical Medicine, the American Society of Tropical Medicine and the National Malaria Committee met at Memphis, Tennessee, November 21–24, 1939, and unanimously endorsed the program of the committee. The council of the American Academy of Tropical Medicine also expressed its cordial approval of the selection of Dr. L. T. Coggeshall as a member of the committee.

The Symposium on Malaria, May 29–30, 1940, in Atlanta, Ga., called by Surgeon General Parran, for the purpose of a preliminary discussion of the malaria situation in our country, with special emphasis on chemotherapy, was attended by Drs. Coggeshall and Small of the committee.

Section N of the American Association for the Advancement of Science, at its Philadelphia meeting, December 27, 1940, to January 2, 1941, will hold a symposium on the human malarias, in which members of the committee will participate. The proceedings of this symposium when published will constitute an important review of present knowledge of this disease.

Active cooperation has been promised by an extensive list of educational and research institutions, scientific and technical organizations, manufacturers and individual scientific investigators, including the following:

Advisory Commission to the Council of National Defense, Edward R. Weidlein, executive, for Industrial Division C, Chemical and Allied Products, Industrial Materials Department (Edward R. Stettinius, Jr., commission member).

American Association for the Advancement of Science, Malcolm H. Soule, secretary of Section on Medical Sciences (N).

American Chemical Society, Divisions of Biological Chemistry, of Medicinal Chemistry and of Organic Chemistry.

American Drug Manufacturers Association, Carson P. Frailey, executive vice-president and secretary.

Army and Navy Munitions Board, Warren N. Watson, secretary, Chemical Advisory Committee.

Cinchona Products Institute, Norman Taylor, director.

Harvard University Committee on Pharmacotherapy, Soma Weiss, chairman.

Institut Pasteur d'Algérie, Algiers, Edmond Sergent, director.

Manufacturing Chemists Association, Warren N. Watson, secretary, and George W. Merck, chairman of Medicinal Chemicals Section.

National Conference on Pharmaceutical Research, John C. Krantz, Jr., secretary.

National Research Council Division of Medical Sciences, Lewis H. Weed, chairman, and Perrin H. Long, chairman of its Committee on Chemotherapeutic and Other Agents.

National Research Council Survey of Research in Industry, F. W. Willard, chairman.

School of Tropical Medicine, San Juan, Puerto Rico, George W. Bachman, director.

Tennessee Valley Authority, F. L. Roberts, University of Tennessee.

U. S. Department of Commerce, C. C. Concannon, chief, Chemical Division, Bureau of Foreign and Domestic Commerce.

U. S. Department of the Navy, Rear Admiral Ross T. McIntire, Surgeon General.

U. S. Public Health Service, Thomas Parran, Jr., Surgeon General.

U. S. War Department, Major General James C. Magee, Surgeon General.

The objects of the committee include:

1. Chemistry in the service of medicine, with special emphasis on the discovery of new and useful synthetic drugs.

2. To bring about a closer cooperation between chemists and pharmacologists interested in the same field. It often happens that an organic chemist synthesizes a new compound of therapeutic possibilities but does not know to whom to turn to have it tested. Similarly, a pharmacologist discovers that a certain chemical exhibits hitherto unsuspected physiologic effects but has no information as to which organic chemists could help him in the preparation of the compound and its more promising derivatives.

3. To help in this direction, the committee should function as a general clearing house for the collection and classification of information as to the chemists, manufacturers, pharmacologists and others in the United States who are now at work in this field, the special lines of investigation they are following and any other pertinent data. With this information in hand, and that accumulated last summer by the survey of research resources of educational institutions, in men and material, now classified and on file in the offices of the division of chemistry and chemical technology of the National Research Council in Washington, we should be able more intelligently to allocate and evaluate the various research problems to be investigated. In this way we can also be of some assistance in reducing the amount of unintentional duplication and overlapping in research work and suggest important problems for investigation where the need seems clearly indicated.

4. Not to undertake too ambitious a program at the outset, since the field of chemotherapy is a vast one. For the reasons explained in the foregoing pages, malaria has been selected as the first disease to be attacked.

5. To prepare a compact semi-popular presentation of the malaria situation throughout the world, particularly in our own land, including a summary of what is going on here and how it is retarded and handicapped by lack of funds, for the purpose of enlisting public appreciation and support.

6. To secure funds from interested individuals, institutions, foundations, firms and others for the support of the work of the committee, the establishment of research fellowships and such other activities as will advance and expedite the achievement of the results sought.

Such a survey is now being conducted to ascertain what investigations are under way or planned for the synthesis of new and useful antimalarials, to compile a list of individuals and firms interested in this field, just what they are doing and (as far as may be possible) in what other directions they are arranging to expand.

Simultaneously, bibliographies, reviews and digests of the literature covering various aspects of the problem are being compiled, but all this work can progress but slowly under existing limitations, and speed is urgently needed; for the medical profession confidently predicts a malaria peak this year or next.

Those individuals, organizations, institutions and manufacturers who are willing to cooperate by supplying the information suggested in the foregoing pages are requested to communicate with the chairman of the committee, whose address until September 20 will be Belgrade Lakes, Maine; after that, Havemeyer Hall, Columbia University, New York.

As this committee has been for some time in touch with many others interested in antimalarials both in this and in other countries and has accumulated considerable information of value, it seems to us wise to publish this statement, in order that confusion and duplication of effort may be avoided and national preparedness advanced more speedily, for we have been informed that other committees and groups have been or are about to be organized to cover much the same field, evidently unaware of the existence of our committee and its activities.

LOWELL T. COGGESHALL
LEONARD H. CRETCHER
LYNDON F. SMALL
TORALD H. SOLLMANN
MARSTON T. BOGERT, *Chairman*

SPECIAL ARTICLES

THE ISOLATION IN PURE FORM OF THE INTERSTITIAL CELL-STIMULATING (LUTEINIZING) HORMONE OF THE ANTERIOR LOBE OF THE PITUITARY GLAND

SHORTLY after proof of the secretion of gonadotrophic hormones by the anterior lobe of the pituitary body had been offered by the work of Smith,[1] Zondek and Aschheim,[2] and a number of later investigators,[3] it was suggested that the effects of implants or crude extracts of the pituitary on the gonads should be attributed to at least two hormones (follicle-stimulating and luteinizing hormones). This view-point was supported by Fevold, Hisaw and their collaborators and, more recently, by work in this laboratory and in that of H. M. Evans. However, some investigators are not satisfied that more than one gonadotrophic hormone can be extracted from the gland and have awaited the isolation of pure hormones which should satisfactorily correct the existing confusion with regard to the possible number and effects of the gonadotrophic hormones postulated by others. In New Brunswick,[4] considerable progress had been made in isolating a hormone[5] stimulating the interstitial cells of the male or female gonads. This material was not chemically pure but was found to be free of other pituitary hormones. The work here reported describes the isolation of this hormone as a pure protein.

The initial extraction of gonadotrophic hormones from the pituitary glands of swine was undertaken by a method already described.[6] The interstitial cell-stimulating extract free from other hormones was then isolated by a second procedure.[4] Electrophoretic studies were carried out on this preparation in a Tiselius apparatus,[7] using the scanning method of Longsworth[8] for obtaining the electrophoretic patterns. Experiments were performed over a range of pH values from about 4.5 to 8.0 at a constant ionic strength of 0.05, using the monovalent buffers, acetate, cacodylate and diethylbarbiturate. The results showed the presence of three components (Fig. 1 A). After sufficient separation of the electrophoretic boundaries it was possible to isolate two fractions, one containing the major component, the other the two minor ones. The biological activity was found to be entirely in the main component. A plot of mobility against pH showed the isoelectric point of this main component to be at pH 7.45. The isoelectric points of the contaminating, inert components fell between pH 4 and 5.

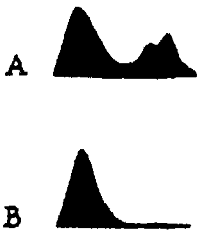

FIG. 1. Electrophoretic patterns at pH = 7.85. A—Before final purification. B—After final purification.

This information made it possible to secure the pure hormone by isoelectric precipitation. To a concentrated solution of the material thus studied, ammonium sulfate was added to one third saturation and the pH was adjusted to 7.3–7.4, as measured by the glass electrode. The precipitate, after the separation of the solvent by centrifugation and the removal of the solvent, was dissolved in water; saturated ammonium sulfate solution equal to one half of the volume of water used was added, and the pH was again adjusted to 7.3–7.4. These steps were repeated seven times, and the final precipitate was dissolved in a small volume of water; the solution was then dialyzed free from ammonium sulfate. (The supernatant fluids contained considerable amounts of hormone and were set aside for further recovery.) The product obtained appeared as a single component (Fig. 1 B) in electrophoretic analysis of solutions having different pH values, with mobilities of -3.85×10^{-5} at $pH = 4.58$, -2.01×10^{-5} at $pH = 6.21$, and 0.66×10^{-5} at $pH = 7.86$. The material was found to show the phenomenon of "reversible boundary spreading" which is usually observed with globulins. That is, after electrolyzing for a certain length of time, reversal of the current results in a sharpening of the boundary. This indicates that the spreading of the boundary observed with increased time of electrolysis is not due entirely to diffusion but results from the fact that the material consists of molecules corresponding to a range of mobility within relatively narrow limits. If one takes the view that native proteins exist as folded molecules, such mobility ranges may be due to minor variations in folding corresponding to little or no energy differences, but yielding slight variations in the surface charge distributions which in turn result in corresponding mobility variations.

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[1] P. E. Smith, *Anat. Rec.*, 32: 221, 1926.

[2] B. Zondek and S. Aschheim, *Klin. Wschr.*, 6: 248, 1927.

[3] H. B. van Dyke, "The Physiology and Pharmacology of the Pituitary Body," Chicago, I, 1936; II, 1939.

[4] R. O. Greep, H. B. van Dyke and B. F. Chow, *Jour. Biol. Chem.*, 133: 289, 1940.

[5] Evans, Korpi, Simpson, Pencharz and Wonder (*Univ. Calif. Pub. Anat.*, 1: 255, 1936) isolated an interstitial cell-stimulating fraction which was considered not to cause luteinization. Later, Evans, Simpson, Tolksdorf and Jensen (*Endocrinology*, 25: 529, 1939) concluded that the same fraction can bring about both interstitial cell-stimulation and luteinization.

[6] B. F. Chow, R. O. Greep and H. B. van Dyke, *Jour. Endocrinol.*, 1: 439, 1939.

[7] A. Tiselius, *Tr. Faraday Soc.*, 33: 524, 1937.

[8] L. G. Longsworth, *Jour. Am. Chem. Soc.*, 61: 529, 1939.

Preparations of the hormone in different degrees of purity were also studied in the ultracentrifuge. The apparatus used was of the air turbine drive type described by J. Bauer and E. Pickels.[9] The sedimentation rate was followed by the scale method of Lamm and the "schlieren" method of Philpot as modified by Svensson. Both methods gave identical results. The solvent commonly used was an aqueous solution of 1 per cent. or 0.5 per cent. sodium chloride. In one case the solvent was a cacodylate solution ($pH = 6.2$) which was used in the electrophoretic studies. Seven runs were made on preparations of different degrees of purity. The least pure preparation, in which three components were detected in electrophoretic studies, showed four well-separated boundaries. Two of the impurities sedimented at a faster rate than the biologically active main component (the fastest at three times the rate), whereas the third impurity sedimented at one half the rate of the hormone. A "schlieren" diagram of the sedimentation of the pure hormone can be seen in Fig. 2. The diagram represents the positions of the boundary moving from right to left at half hour intervals under a mean field of 2.37×10^{8} cm/sec.[2]

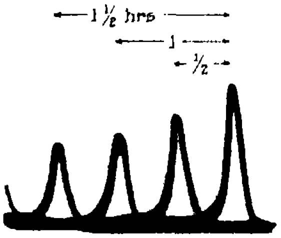

FIG. 2. Sedimentation patterns of the hormone after final purification.

(57600 r.p.m.). The symmetry of the curves and the absence of any displacement of the base line with time indicate the purity of the hormone in agreement with electrophoretic patterns and solubility tests.[10] The average sedimentation constant in a 1 per cent. sodium chloride solution was $S_{20} = 5.39 \times 10^{-13}$, the maximum deviation from this average value being ± 1 per cent. (An abnormally high value of $S_{20} = 6.65 \times 10^{-13}$ was found for the cacodylate solution.) The diffusion constant determined in the cacodylate medium was found to be $D^{20} \cong 5.9 \times 10^{-7}$, this value decreasing with time. From these data the molecular weight may be estimated to be approximately 90,000, assuming the value 0.749 for the specific volume of the hormone.

An example of the results of a study of the solubility of the hormone is shown in Fig. 3. The solvent used was 0.25 M acetate buffer, $pH = 4.35$, containing 21.05 per cent. sodium sulfate. The solution remained water clear after the first addition of hormone (0.015 mg N per cc), but became turbid when 0.020 mg of N was present in each cc of solvent. The solubility then and thereafter was constant (0.018 mg N per cc), although the amount of hormone suspended in the solvent was nearly sixteen times the saturating concentration. Therefore, within the described limits, only

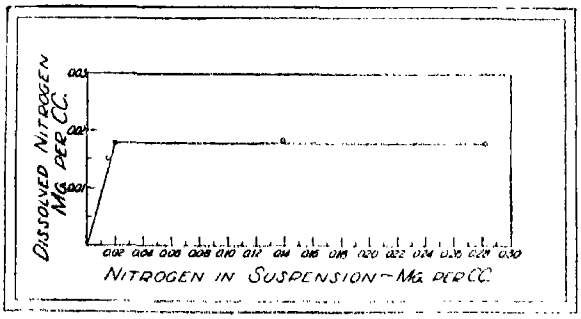

FIG. 3. Solubility of the hormone in 0.25M acetate buffer, $pH = 4.35$, containing 21.05 per cent. Na_2SO_4.

---

[9] T. Svedberg, "The Ultracentrifuge," Oxford, 1939.

[10] Close inspection of the plate revealed a faint residual trace of the impurity sedimenting slightly faster than the hormone.

one component was demonstrated, since the solubility of this component was constant whether the solution was just turbid or whether a great excess of hormone was in suspension. These results, agreeing with the studies made with the Tiselius electrophoresis apparatus and the ultracentrifuge, furnish proof of the purity of the hormone by the only other available physical chemical test.

The results of analysis of one specimen of pure hormone were: carbon, 49.37 per cent.; hydrogen, 6.83 per cent.; nitrogen, 14.93 per cent.; ash, 0.93 per cent.

All the assays were performed in rats hypophysectomized at an age of twenty-one days. Injections were begun two days later and were given subcutaneously once daily for four days.[11] At necropsy, twenty-four hours after the last injection, the appropriate organs were weighed and then fixed in Bouin's fluid. Typical results are shown in Table 1. Owing to stimulation of the testicular interstitial cells, 1 microgram of hormone nitrogen caused a significant increase in the fresh weight of the anterior lobe of the prostate ($P = < 0.05$ by Fisher's method of paired comparisons). A dose of 2 micrograms of hormone nitrogen was required to produce an increase of testicular weight ($P = < 0.05$). This testicular hypertrophy was probably caused chiefly by the action of secreted androgen on the germinal epithelium. In hypophysectomized, immature female rats, the hormone maintained the interstitial cells. However, if it was administered after follicle-growth had been stimulated by follicle-stimulating hormone, it caused the formation of corpora lutea perhaps preceded by ovulation. Our results indicated that the secretion of oestrogen did not occur following the injection of follicle-stimulating hormone into hypophysectomized rats, although the growth of histologically normal follicles was clearly present. If, however, interstitial cell-stimulating hormone was also administered, all the morphological phenomena of oestrus were provoked.

TABLE 1

Dose micrograms of nitrogen	Number of rats	Mean and S.E. of wts.		
		Body gm	Ant. lobe prostate mg	Testes mg
--	8	48.5 ± 2.90	8.49 ± 0.549	130.7 ± 5.25
1	9	52.4 ± 2.49	11.01 ± 0.695	142.0 ± 7.35
2	6	49.3 ± 3.62	16.97 ± 0.624	160.8 ± 12.10
10	5	44.9 ± 1.18	34.58 ± 2.130	209.6 ± 7.91

SUMMARY

Interstitial cell-stimulating (luteinizing) hormone was isolated from swine pituitary glands. This protein hormone, having a molecular weight of about 90,000 and an isoelectric point of pH 7.45, was shown to be pure by tests in the electrophoresis apparatus of Tiselius and in the ultracentrifuge as well as by its constant solubility. The hormone stimulated the interstitial tissue of the testis or ovary and caused the formation of corpora lutea provided that maturing follicles were present. Under the conditions described, its minimal effective total dose in hypophysectomized immature male rats was about 1 microgram of nitrogen or 6.7 micrograms of hormone. Extracts of swine pituitary with purely follicle-stimulating effects did not cause oestrus in immature hypophysectomized female rats unless luteinizing hormone was also administered.

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---

[11] Results of other investigators indicate that intraperitoneal injection would have provoked a greater response.

SYNTHESIS OF THE PYRIDINE ANALOG OF VITAMIN B_1

THE concept of isosterism as proposed by Grimm[1] and extended by Erlenmeyer[2] has recently attracted attention by its possible application with respect to the substitution of a pyridine nucleus for the thiazole component of the thiamine (vitamin B_1) molecule. As part of a general study of various pyridine derivatives in this laboratory, one of us[3] recently described the preparation of 2-(β-hydroxyethyl)-3-methylpyridine and the condensation of this substance with the pyrimidine component of thiamine. Meanwhile, others have reported the synthesis of what was assumed to be 2-methyl-3-(β-hydroxyethyl)-pyridine, and from this the preparation of a substance presumably isosteric with thiamine by condensation with the appropriate pyrimidine. Schmelkes[4] described an isosteric vitamin as well as the substances formed by condensation of what he believed to be 2-methyl-5-(β-hydroxyethyl)-pyridine with the thiamine pyrimidine. He reported anti-polyneuritic activity for the former. Baumgarten and Dornow[5] arrived at Schmelkes' antipolyneuritic substance by a different route and reported its activity as being about one-twenty-sixth that of thiamine. However, in a later paper, Dornow[6] showed that the assumed β-hydroxyethylpyridine derivative of both workers was in reality the α-hydroxyethyl derivative. The true isoster of thiamine has, therefore, not been described, and we wish to report its synthesis at this time.

---

[1] Grimm, *Naturwiss.*, 17: 535, 557, 1929.

[2] Erlenmeyer *et al.*, *Helv. Chim. Acta*, 16: 733, 1381 (1933); 20: 1388 (1937) inter alia.

[3] Finkelstein and Elderfield, *Jour. Org. Chem.*, 4: 365, 1939.

[4] Schmelkes, SCIENCE, 90: 113, 1939; Schmelkes and Joiner, *Jour. Am. Chem. Soc.*, 61: 2562, 1939.

[5] Baumgarten and Dornow, *Ber.*, 73: 44, 1940.

Ethyl α-(β-ethoxyethyl)-β-aminocrotonate condenses smoothly with diethyl malonate in the presence of sodium ethoxide[7] to give 2-methyl-3-(β-ethoxyethyl)-5-carbethoxy-4,6-dihydroxypyridine. Elimination of the carbethoxy group in this substance by saponification and decarboxylation and of the hydroxyl groups by replacement by chlorine and subsequent catalytic reduction of the dichloropyridine gave 2-methyl-3-(β-ethoxyethyl)-pyridine (picrate, m. 63–64°; calculated for $C_{16}H_{18}O_8N_4$: C, 48.7; H, 4.6; found: C, 49.0; H, 4.4). Cleavage of the ether group in this compound gave 2-methyl-3-(β-hydroxyethyl)-pyridine, the position of the substituents in which was shown by oxidation to quinolinic acid. The pyridine crystallizes with one water from chloroform-petroleum ether, and the water is not lost on distillation at 0.5 mm. pressure. The hydrate melted at 61–62° (calculated for $C_8H_{11}ON \cdot H_2O$: C, 61.9; H, 8.5; found: C, 62.2; H, 8.8). The picrate melted at 123–124° (calculated for $C_{14}H_{14}O_8N$: C, 45.9; H, 3.9; found: C, 46.3; H, 4.1). The above pyridine was condensed with 2-methyl-5-bromomethyl-6-aminopyrimidine hydrobromide to give 1-[(4-amino-2-methyl)-5-pyrimidylmethyl]-2-methyl-3-(β-hydroxyethyl)-pyridinium bromide hydrobromide, the true pyridine analog of thiamine, which charred at 240–260° dec. (calculated for $C_{14}H_{20}Br_2N_4O.H_2O$: C, 38.4; H, 5.1; found: C, 38.5; H, 4.6).

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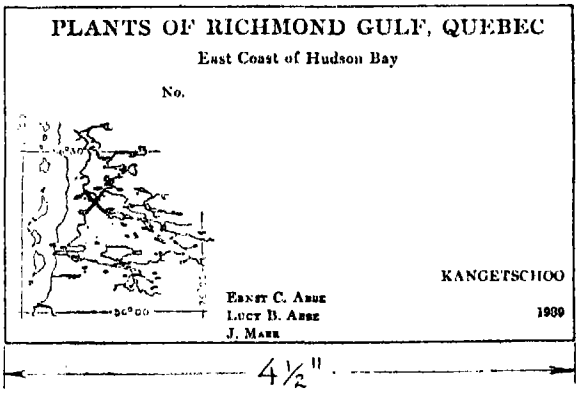
SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF OUTLINE MAPS ON HERBARIUM LABELS

THOSE who have had occasion to use herbarium specimens in distributional studies have experienced the aggravations attendant upon unsatisfactory definition of the localities listed on the labels. The problem affects not only ecological research and floristic plant geography, but also monographic taxonomy. In the experimental fields adjacent to taxonomy it is especially desirable to be able to return to the localities represented by herbarium specimens.

In regions which are well mapped, current practice often partially fulfils the above requirement through the indication of locality by township and range, by county or by latitude and longitude. Even greater precision would be desirable for some studies, such as in ecology and the genetical aspects of ecology and taxonomy.

For plants from regions which are poorly mapped or for which accurate maps are not generally available, such as that visited by the University of Minnesota Expedition to Hudson Bay,[1] there may be recommended the type of label illustrated in Fig. 1. The outstanding difference between this and the conventional labels is the inclusion of an outline map of the area, which results in a slightly larger than average size label (as indicated in the figure). There still remains generous space on the herbarium sheet for the plants and abundant space on the label for further data. The indication of the specific location at which the specimen was collected merely involves the insertion of a symbol (shown with an X in the figure) in the appropriate place on the outline map on the label. The added cost of this type of label is primarily accounted for by the cost of the zinc etching—in this case (at local prices) about $1.25. Thus the added cost per thousand labels is negligible.


PLANTS OF RICHMOND GULF, QUEBEC
East Coast of Hudson Bay
No.
KANGETSCHOO
ERNST C. ABBE
LUCY B. ABBE
J. MARR
1939
56°30'
56°00
4½"

The objection might be raised that a simple indication of latitude and longitude would be sufficient; but in poorly mapped regions an area may be very inadequately located with respect to the parallels of latitude and longitude. Furthermore, such regions are seldom shown in adequate detail even in the best atlases.

The locations of place names not given on standard maps and of places wholly lacking accepted names but to which temporary or local names have been given are clarified through the use of a map on the label. Such place names *may* be elucidated in diaries or in field note-books or in general accounts of collecting trips. Too frequently, however, these sources are not available to, or known by workers in the herbaria to which the specimens finally find their way. Frequently, too, such scattered and obscure sources of vital information become lost, and occasionally the place names used seem never to have existed except in the mind of the collector.

---

[6] Dornow, *Ber.*, 73: 353, 1940.

[7] Knoevenagel and Fries, *Ber.*, 31: 767, 1898.

[1] Abbe, SCIENCE, n. s., 90: 458, 1939.

Since the method here described leads to precision in floristic studies and involves only slight additional cost in time and money over the conventional method of labeling, it should find ready use not only in the field of botany but in any field where precision in recording the source locality of natural objects is of importance.

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A SPATULATE PIPETTE SERVING AS SECTION LIFTER

Doubtless one of the most distressing manipulations in the histo-pathological laboratory is the handling of frozen sections of tissue or of transferring celloidin sections from fluid to fluid. In the first case, a partial or total loss of a section is the rule rather than the exception. One reason for such high casualty is the want of suitable tissue carriers. The most commonly used carrier is a glass rod, but to this the tissue frequently adheres so completely that destruction of the section during the attempt to loosen it and spread it out is unavoidable. Some workers employ a spatula, a micro-slide or a brush, and though such appear to be preferable to the glass rod, considerable loss of sections is admitted.

A former associate, Dr. Baeslack (d. 1929), at the University of Würzburg, manipulated frozen sections with pipettes made from glass tubing of various sizes. In this way a section remains suspended in its liquid medium (water, alcohol, dye, etc.) while being transferred, and consequently the possibility of the loss of the section is reduced to a minimum, since it is not touched mechanically until it is placed on the slide. But a tube with a round lumen encourages the frequent twisting and folding of the section, making it difficult to flatten it. The writer overcame this disadvantage by making a flattened pipette, as illustrated in Fig. 1. The device is published here at the suggestion of Professor Kampmeier, who was impressed by its simplicity and effectiveness. Its usefulness as a section "lifter" or "carrier" has been demonstrated sufficiently well in our laboratory to bring it to the attention of other workers.

To make a spatulate pipette, one end of a thin-walled glass tubing with an inner diameter of about 7 mm (approx. ¼ inch) is heated in the flame to plasticity and placed between asbestos-covered jaws of a pair of pliers. To prevent cracking of the glass tube as the jaws are gently squeezed down on it, the asbestos must of course also be hot. With a little practice a uniformly flat chamber is made from suitable glass tubing, the size of the opening or slit being varied according to need; a slit 1 cm long and 2 mm in height or width is generally adequate. The tube is then slightly bent, as shown in Fig. 1, to make it handier. A rubber bulb, as used on eye-droppers, is attached to the round end of the tube to complete the instrument. It is imperative that the pipette is always clean to prevent the sticking of the section to the glass as it is drawn into the lumen. For similar reasons any sharp edges at this end of the pipette must be rounded in the flame.

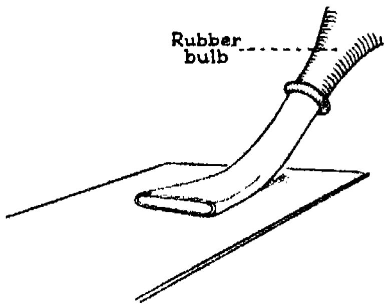

Fig. 1.

It is hardly necessary to add directions regarding the use of the spatulate pipette, so obvious are its advantages. When transferring a frozen section, for example, to a slide, it is allowed to be drawn into the slit of the pipette slowly and in a flattened condition with the fluid in which it is suspended. The middle of the slide is then flooded with a little additional fluid and the section expelled under gentle pressure so that it floats on the pool on the slide. The excess fluid is drained or sucked off with the pipette, letting the section settle flat on the slide. Should the section be crumpled or folded in part, fluid is rushed under that part which needs correction, meanwhile tilting the slide downward in the same direction; this maneuver prevents the section from separating from the slide.

Emil Maro Schleicher

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Annual Report of the Rockefeller Foundation, 1939. Pp. 507. Illustrated. The Foundation, New York.

Babor, Joseph A. and Alexander Lehrman. *General College Chemistry.* Pp. xiv + 659. 150 figures. $3.75. *Laboratory Manual for General College Chemistry.* Pp. 289. 46 figures. Crowell.

Comstock, John H. *An Introduction to Entomology.* Ninth edition. Pp. xix + 1064. 1228 figures. Comstock Publishing Company. $5.00.

Holman, Richard M. and Wilfred W. Robbins. *Elements of Botany.* Third edition. Pp. xi + 392. 277 figures. Wiley. $2.75.

Neckers, J. W., T. W. Abbott and K. A. Van Lente. *Experimental General Chemistry.* Pp. vi + 282. 22 figures. Crowell. $1.75.

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TRENDS IN ENGINEERING EDUCATION[1]

By Professor DUGALD C. JACKSON

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1. INTRODUCTION

ALAN SEEGER started his most famous poem with the lines:

> I have a rendezvous with death
> At some disputed barricade,
> When Spring comes back with rustling shade
> And apple blossoms fill the air;
> I have a rendezvous with death
> When Spring brings back blue days and fair.

We well may think of those words as we contemplate the state of engineering and its past and present relation to civilization. The rendezvous calling to us as engineers and teachers differs from Alan Seeger's. That was a rendezvous with death, but not with failure. In our calling of engineering education, we have a choice of a rendezvous with sterility and failure, or a rendezvous with progress and achievement which are helpful to society and associated with service to our groups of students. We who are in engineering education, and also all who are engineers, have been and are being sharply criticized for the outcomes of our labors; but it is to be remembered that much which is talked and written about education in its various levels and orders, including engineering education, and much which is talked and written about engineering technology is shimmering mirage instead of true substance. The fact is before us and is a background for what I have to say, but I can not elaborate upon this here.

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[1] Address at annual dinner of the Middle Atlantic Section of the Society for the Promotion of Engineering Education, May 4, 1940.

Benjamin Franklin is credited with saying that prose writing should be smooth, clear and short.

The fact that constructive progress in engineering education is now stirring is demonstrated by such affairs as the admirable mutual relations arising from the activity of the Committee on Engineering Schools set up by the Engineers' Council for Professional Development, with which this society is so intimately associated; and also by such reports as that of our Committee on Instruction in English in the Engineering Colleges and of our Committee on Aims and Scope of Engineering Curricula, both of which reports were recently published. We may well wish that the latter committee had found it possible to take time to expound more fully the experience and evidence which established the underlying reasons for their beliefs and conclusions, for we know that the course of progress in erecting such a structure begins with examination of data or specimens and their statistical classification, as in the development of the various sciences. However, this report tells us that "engineering education rests on a foundation of science, of humanities, and of sound relationships rather than on the practical techniques of particular occupations or industries"; and it gives a summary of objectives which deserves to be read and pondered over.

I will here deal only with major influences. Details are treated in such Society for the Promotion of Engineering Education committee reports as have just been referred to, and in the special report prepared on behalf of the Committee on Engineering Schools of the Engineers' Council for Professional Development, entitled "Report on Status and Trends of Engineering Education in the United States." This report is long, but it is intended for personal study and annotation—for which reason it has no formal index. In what follows, I will try to be exact because philosophical discussion often takes the character of bartering misty thinking among the debaters.

As long ago as 1893, Professor R. H. Thurston said in a contribution to the *Proceedings* of this society; "Upon the thorough education of our engineers depends very largely the future progress of this nation." Quite recently, Dr. W. S. Learned, of the Carnegie Foundation, has expressed his opinion as follows: "I know of nothing more hopeful for society than to combine a good engineering education with a sound philosophy." Each of these pertinent sayings infers that we desire progress. But, what is "progress"? In reflecting over this some time ago, I formulated a definition—"Progress involves the development and satisfaction of wants which are of a higher order." That definition leaves us still drifting. What are "wants of a higher order"? Truly, we must look sharply to be sure that our rendezvous is with progress and achievement and not with sterility.

2. Relation of Engineering to Civilization

"To live, the early Egyptians had to tame the jungle, drain, ditch and irrigate their fields. This required not only technical advances, but a high degree of social discipline. But out of it came a pioneer civilization of the world." Thus speaks a recent analytical history of the world. The same statement of conditions may be made for the probably equally early settlements of the valleys of the Tigris and Euphrates and other favorable areas. Note that, to live, these primitive peoples near the dawn of written history had to "drain, ditch and irrigate." That is, it was on crude engineering that these primitive peoples relied, associated with a degree of "social discipline"; and on that combination was built their early civilization. Note, also, that the "social discipline" already was in the world among prehistoric people in Europe, who developed a crude engineering which enabled them to construct and live successfully in communities. The dwellers' relations in each community compelled the gradual formulation of codes of ethics and rules of morality. Professor George F. Moore, distinguished scholar and authority on the history of religion, has said: "Civilization develops only where considerable numbers of men work together for common ends. Such unity is brought about, not so much by community of bare ideas, as by community of the feelings by which ideas are emotionalized and become beliefs and motives." He farther points out that political, geographical and climatic, and economic features are not to be ignored because they may explain peculiarities of particular civilizations, or their rise or fall—but they "do not account for civilization itself."

Thus the seeds of civilization were sown, and engineering aided in that sowing. Engineering and civilization ever since have marched together—each encouraging and influencing the other. As the experience of man over the untold thousands of years enlarged his intelligence, he improved his engineering and his civilization profited by it. Communication became more readily accomplished between man and man, between community and community, and even between tribe and tribe; so that practices which added to safety, convenience and comfort among one group became known and used among other groups even in distant places.

Cupidity (greed) and the lure of barbarous excitements seem to have been among the first intrinsic human qualities, and they still are intrinsic. The two influences—(1) engineering with its possibilities for providing health, comfort, convenience and opportunities for happiness and (2) the innate cupidity coupled with love of barbarous excitement—are antagonistic and have been so as far back as records go. Murder, arson, cruelty, corruption, immorality, slavery and brutal wars are dominant features of the records of all parts of the world for which records remain. If there has been any change in the extent and repercussions of these horrid activities of man, I am willing to place my wager on their having become ameliorated (considering the world as a whole) century by century during the ages only a little.

Those who paint the bad state of present-day civilization compared with the periods long gone by are not scattering original thoughts. That same plaint has been heard for millennia of years; and if the retrogression has so continued through the years, our far ancestors must have been veritable angels—or else we now are in terrible case. I have discussed this at greater length in a small book entitled "Engineering's Part in the Development of Civilization," which is published by the American Society of Mechanical Engineers. This is a book intended to be read thoughtfully and reflected over for the purpose of getting a better understanding of where we stand as engineers, why we are here, and the what of future opportunities and responsibilities for engineering. However, not all the learned ancients were sure the world was retrograding—which also is true of some of our moderns.

I already have referred to the application of crude engineering in drainage and water distribution in the early settlements of the Valley of the Nile, the Valleys of the Tigris and Euphrates, and elsewhere, which enabled the several peoples to live under favorable conditions for their early times and to develop notable civilizations of their particular types. Most of those developments lost their status as a consequence of external and internal wars. The peoples possessing, for their times, highly developed arts and technology fell before cruder and more hardy hordes. Why this should be is not clear. Many questions stand unanswered. Did the more leisurely life of art, agriculture and technology cause in the civilized groups a touch of abstraction and indifference and a softness which made them incompetent for self-protection against the invasions of barbarians? Was the overthrow in all cases the result of war? If not, what were the causes underlying the downfall where barbarian war was not the cause?

Especially, was loss of engineering skills and techniques the primary cause of the downfall of Persian and Arabian civilizations; and of the Arabs in North Africa toward and after the middle of the Christian Era? What of the Mayans and certain of the ancient tribes of the South American Andes? Were their engineering skills (great as they were for their times) inadequate to enable them to cope with changing climates or other natural cataclysms, which left only the alternatives of adaptation or extinction? If we had the answer to all these and some like questions, then we might correctly appraise our present state.

It seems to be a determined historical fact that small parcels of land alone, farmed by individual families, can only support such families in relative poverty. In the same geographical locations, large land-owners can become individually wealthy through purely agricultural interests, but only by the utilization of human slavery or the exploitation of driven hired-workers. The introduction of local mechanical industries and general commerce changes all that. The cheapening of needed industrial products and the increasing local demand for foodstuffs and for raw materials for the industries make it possible for the small land-owners of intelligence to farm with moderate profit and improve their level of living, and also possible for the large land-owners to maintain moderate wealth while subscribing to reasonable conditions of work and pay for their workers.

Much of the apparent failure to learn by historical precedents is due to the fact that the world is new in its relation to the minds of each generation; and generations have an unconscious wish to find the way by original experience through the processes of trial and error. It is in the nature of immature men to be wishful thinkers. The same fault is strengthened by the practice of historians in former generations to extol the glories of dynasties and of military victories, and say little about the lives of the masses of people and the social, economic and technological conditions surrounding them. Historical treatises therefore have provided no sufficient touchstone with which to test the effects on the life of the masses of peoples which have arisen from engineering inventions and engineering industries.

Let me emphasize the fact that engineering is the tie which bridges the chasm lying between the mathematical, physical and biological sciences as one abutment and the human phenomena of economics and sociology, with their psychological qualities, and which jointly constitute political economy, as the other abutment. As a field of learning or of action, political economy is all bound up with human aspirations and passions. It is difficult to spin out uniform and sound threads of thought in its field unless and until psychologists identify and define the fundamental elements in the mainsprings of man's thinking, and then discover the principal relationships between stimulus and response. Many of the misinterpretations of the relations of engineering with present-day civilization arise because so little is factually known regarding these psychological elements in man's thinking. It is also a fertile cause of misinterpretations that human incidents in history are not more fully and widely known.

Here is an illustration that man's innate processes of thinking and acting change very slowly: What better description of the qualities exhibited in the ravishing of Austria, Czecho-Slovakia, Poland, the occupation of

Denmark and the attempt on Norway than the following: "... that bitter and hasty nation, which will march through the breadth of the land, to possess the dwelling places that are not theirs. They are terrible and dreadful: . . . They shall come all for violence: . . ." This might well have been written in the year 1940, but in fact, it comes from the Old Testament book of Habakkuk, which is supposed to have originated about 2,400 years ago, and the nation referred to is definitely named as the Chaldean. The quotation is a transcript from the King James translation, which was first published over three hundred years ago. There is no suggestion or inference in the trenchant charge against "that bitter and hasty nation" that it was enabled to carry on its violent career because the development of technology had outrun utility, as the charge is made against us to-day.[2] It is obvious that man (both individually and collectively) has not yet become convinced that a life of honesty and fair dealing is more profitable in the long run than the reverse. An apparent profit of the moment still looms larger in most human eyes than the dribbling profits of the long run. Here is a great field of education crying for the attention of sociologists and philosophers.

As badly off as we may be in this country compared with abstract possibilities, we nevertheless have reason to hold up our chins. I will quote a bit from one who should know, Louis Adamic, who himself came to us as an immigrant and who now has turned himself to the effort to awaken in us an understanding of our faults and to stimulate a more fully organized mutual effort to overcome them. Referring to the great proportion of our population who were immigrants or are in descent from immigrants, he says that the great majority of them "are humble folk, workers and farmers who skate on thin ice along the margins of our erratic economy. Some are or were on relief, though not nearly so many as generally imagined . . . . There is no doubt, though, that most of them *are economically better off here than they would have been in the old countries*" (italics mine).

It has been asserted customarily that our relatively high level of living for all citizens is due to the wonderful supplies of natural resources to which the people of this nation fell heir. But there is a catch in that. Those natural resources would not have raised our people to their relatively high level of living except for the steady application of a high level of intelligently directed industry associated with the greatest development of engineering technology through scientific discovery and invention which the world has ever experienced. We can continue in the same route and maintain ourselves on a rising level and to an improved civilization through the steady scrutiny and improvement of our engineering by farther exertions in the field of scientific discovery and invention; and with that rests our salvation as a people. Relatively, our ethical and altruistic status has been good, but in absolute measure it has much progress to make.

Before turning to our part as engineers in the great problem of our responsibility previously referred to, I will speak of one other factor. Some 2,000 years ago there was put before the world with astonishing boldness, vigor and vitality the ethical tenet of the brotherhood of man, in the preachings of Jesus Christ which established the doctrines of the Christian religion. The doctrine of the brotherhood of man stands to the front in no other world-religion. It has been thought of as a guide in the western world, with its full adoption to be expectantly worked for. We now know that the expectation has been over-optimistic, for the tenet has not secured a firm hold among certain of the peoples of the world even in the Occident. However, the vitality of the doctrine is proved and its qualities impose an additional responsibility on the followers of engineering—and especially on those of us who live in America, where our substantial freedom of thought and effort is established.

Let us now think of what engineering education is—and why it is. Mathematics, chemistry, physics are largely analytical; political economy is still largely in the classification stage of development; engineering (including invention) is synthetic in the ultimate, because it builds up by transfusion the scientific processes into human welfare. Engineering and civilization originated in an association with human welfare, and both continue to exist because of this continued relation with such welfare. We must accept the fact or we are not fully qualified engineers. As the poet Horace says, "The grape's in the raisin." We can not dodge the fact.

Engineering education has for its purpose the provision for its students of knowledge and wisdom in certain fields. This requires a reasonably successful effort on the part of the students to become filled with a knowledge of facts of nature and their relationships, and with facts regarding man and his relationships, and to become wise in adapting the phenomena of nature to the service of man. Thus stated, the total field is seen to be illimitable in its scope, and individual students choose defined portions in accordance with their tastes. In the early days of formal engineering education, the situation was relatively simple, because so little of the total scope of engineering was as yet drawn into an intellectual discipline or a series of such disciplines. Most of us then expected to deal with structures or means of transportation, or perhaps both, and the relations of these to public welfare were quite definite. But we now have a series of disciplines amongst which each student chooses that which he prefers to follow in a major way; the activity in scientific discovery and invention has resulted in a vast scope of engineering industries, for which the relations to human welfare are no longer definite; and study of these relations has become a compelling part of engineering education.

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[2] The cynically brutal violation of Belgium and Holland has occurred since the date of this address. The analogy with the barbarous Chaldeans is not lessened.

It is here proper to introduce the reminder that stale minds do not come to greatness in engineering any more than they do in poetry, music or art; and the engineering teacher who is commonplace in his teaching of engineering topics is merely opening to his students the entrance gate to the broad highway of mediocrity. Engineering is of the intellect and engineering education in its higher development must be an intellectual education—but cultivation of the imagination, associated with the quality of "carrying through" projects concretely, is a *sine qua non.* The inventor-genius of American engineers has held a great part in the development of a high level of living in the country and it continues in its good effect. This should not be forgotten in planning engineering education. Here is a frontier which can not be pressed back or exhausted while American intelligence is maintained, however actively the exploitation of the frontier's figurative forests and the turning of its figurative sods are carried on.

3. HOW WE ARE MEETING OUR RESPONSIBILITIES TO SOCIETY

From the foregoing, it is easy to see that we are resting in a situation where the engineering schools have special responsibilities because education is not a thing in itself but it is, if properly visualized, for each individual a preparation for living in the setting into which his ambitions lead him. That means that engineering education must be aimed at a sound scientific foundation for engineering, accompanied by an adequate understanding of the influence which progress in engineering exerts on the life of each student and his fellow citizens. We have a nation in which it is intended that men may independently enterprise, build and produce to their own benefit, but with due consideration to the welfare of their fellow citizens and their fellowmen throughout the world. For this environment the engineer must be strong in his character; and for the purpose he must not only have knowledge of nature's phenomena and the characteristics of men, which lie at the heart of engineering, but he must observe acutely, think accurately, express his thoughts both honorably and cogently, and understand and interpret the truth or untruth in the expressed thoughts of others. In the early days of engineering education, the technical aspects were mainly thought of—and the engineer who came to influential place in the profession was compelled to learn the rest mostly by experience. Happily, the trend of engineering education during the past twenty-five years has brought these latter aspects into the realm of the formal educational processes, while the exact details of technical practice have been left more largely to the school of experience. Thus we have recognized a responsibility to society, the depth of which has affected our professional attitude.

If we add to the foregoing a sense of wise tolerance for conflicting views which are sincerely expressed and not logically controvertible, we have reached the scope of a truly liberal education. It is one which responds to the definition of the poet Milton (given in his "Essay on Education") that a complete education is one which fits a man to perform "justly, skillfully and magnanimously" within his sphere. The importance in the affairs of society of this last-named feature of tolerant consideration of sincerely expressed views of others has of recent years, it seems to me, become more strongly impressed in all scientific circles, including engineering; but we can serviceably give more thought to its emphasis in engineering education. It very likely is in the selection and training of teachers for important places in engineering education in which this emphasis should primarily be placed. Of the young teachers we may well say that when the tree is of good root, the fruit will be good. But, to secure the best, the tree must be properly cultivated and sprayed.

However, the responsibility of engineers to society can not be fully met by teachers alone. As the poet Horace said, in effect, of responsibility for hospitality, "No matter how good your wines may be, you must also be sure that you use a high grade of oil on the fish"; and we must get our students to reflect on the economic and social implications of engineering, without lessening their mastery of the scientific relations. The tendency for solving this problem in engineering education is to put more responsibility on the individual students for specific and general study within their chosen fields—with sympathetic direction and supervision by members of the teaching staff. This puts, within limits of a prescribed scope, the degree of responsibility on the students for their self-education and enables each one to go as far within the particular scope as he can and will. This may sound to some ears like an exhibition of unfair partiality, but we must remember that the oak and the palm require different qualities of nurture in order that each may grow to its greatest prosperity and fruitfulness; and that each one, though different from the other, is of value in its individual degree.

Examinations determine whether each student has achieved at least as much as some assumed minimum. Those who can not achieve the minimum are not altogether without merit; and fair play requires that they should be aided in the effort to enter a more appropriate channel. A few engineering schools have awakened to this fact and are utilizing vocational advisory measures for this and other purposes. Common sense consists in seeing things as they are—and this attitude responds to the sentiment of fair play. The elimination of the shallow-minded from among the pursuers of engineering education is an economy; but, principally, it is desirable for the avoidance of over-cultivation which causes mental sterility like the sterility of sub-marginal land which has become exhausted from over-cultivation. We can not afford to be unsympathetic or snobbish in the engineering schools. Our field includes applications to general welfare of the teaching of science and experience; and we may remember that a deep fault of some peoples has arisen from the attitude of powerful educated groups who have sneered at the weakness of the masses and opposed their rise. Our attitude ought to be one of sympathetic aid toward directing each individual into an environment for which he is fitted. Engineers in practice must deal with tremendous numbers of people who are incompetent to substitute in their work, but whose own work is highly needful to the success of theirs.

Some educators argue that special sectioning for classes and special provisions for the more active-minded and sound-thinking students are objectionable because they do not comport with democracy. However, this is a false argument. In no society are all people alike, whether the society is democratic, aristocratic, totalitarian, communistic or what not in form. In a democracy all people should be established in equality of rights, but likeness in quality of mind and ambition is not to be had. The problem in democracy is to enable each individual to achieve to the extent of his ability the practical benefits for himself and the body politic. Intense regard for the very best accomplishment available in an individual is the touchstone for establishing a good reputation. As a consequence, special sectioning of classes in the engineering schools, according to the mental-speeds and abilities of the individual students, is truly democratic.

Moreover, it is just and right that engineering students should exert the effort for self-education, because the benefit accrues to them individually, as well as to society. If each one of us here will reflect on the status of those who are outstanding among his associates, I feel sure that he will become convinced that in most cases concentrated self-chosen study and keen observation of the consequences of experience are the foundation of the elevated achievements. Engineering students should learn in the engineering school, if they have not learned it before, that the moment one quits in the effort of self-education and demands to "be taught," one simultaneously turns one's back on one's individual progress in the profession; but that, as long as one studies and gains additionally the benefits of life and experience, one may expect the efforts to be rewarded.

Happily, these principles are gaining stronger hold among the engineering teachers. Conventional, pedantic and treadmill practices are losing fashion in the engineering schools, pre-digested text-books are not so widely popular as formerly, and the encouragement of independent student thought and effort is more in the style. Easing of the load of conventional class-hours of work assigned to the teachers is needed in many institutions; and advantage would be derived thereby for students and for the engineering profession—even though the result should be that fewer engineering details are dwelt upon by the curricula. A wider use of the exchange of professors among the engineering schools would be helpful in accelerating this reform, by broadening the bases of experience enjoyed by individual teachers.

Most of us here are engineers and teachers of engineering subjects. We thus are bound in two professions—engineering and pedagogy. Engineering is a research occupation which holds our hearts' interest, but we have come to appreciate the importance of sound pedagogical reasoning—or we ought not to hold our posts of teachers. We also have come to a lively appreciation of the importance in engineering curricula of the arts of expression (*i.e.*, the languages and drawing) and of political economy which comprises economics and sociology, because of the important part that the utilization of the former plays in every influential man's life, and the tremendous effect that engineering plays, and has played, in the economic life of the nation and the development of the national, social and political life. We also appreciate the desirability of acquaintance with recreational fields of the nature of music and art and literature.

As engineers, we are jealous of our mastery in our particular engineering topics and, as good teachers, we wish to teach and inspire within their boundaries; that is, on ground which we know best and in areas within which our inquiries may be most interesting to us and fruitful to the nation. We understand the importance to our students of becoming skilful in the arts of expression and qualified in knowledge within the field of political economy, and we ought to insist that only masters in those fields should be drawn upon to teach those tenets to our students. We ought not to desire to ourselves control the teaching of these subjects, because they are not of our mastery and the topics of our own mastery ought to hold us each individually bound.

In this we have been hesitant and have failed to lend full sympathy and encouragement to the teachers in these collateral fields. Indeed, these collateral departments often have been looked upon as ones having nothing more substantial to offer in our educational setting than a rather thin criticism. As a matter of fact, it would be good for all concerned to invite them to prove their interest in solid contributions to education for fully rounded professions. This more sympathetic attitude by the engineering professors toward the collateral departments appears to me to be gradually expanding—but it is worth while to emphasize the lesson of hearty cooperation of all departments for general benefit and for the best interest of overlapping features of the work, remembering that cooperation connotes friendly concurrent effort by a multiple of individuals.

Respecting purely recreational topics, we all recognize that substituting evanescent material in an undergraduate curriculum in place of substantial basic studies is like substituting second-rate concrete in an edifice where only marble is appropriate. However, there are certain features needed to support our work, and happily it is common observation that students in the engineering schools that are located in large cities take general advantage of the excellent opportunities to hear fine music and see great art; and interest in their doing so is expressed often by members of the engineering faculties. It is my inference that the radio carries much good music to engineering students in engineering schools located in the lesser cities. Optional studies now are available for stimulating these interests and interest in literature as well as world interests.

And now I imagine that you are bursting with the question, Why should engineers be held responsible for guarding their work from diversion into paths which are harmful to civilization, while research scientists are not held responsible for making useful applications of their discoveries?

The statement of the question shows the answer. Engineering is the art of directing the forces of nature for the service of man—and any diversion to disservice is false. We may condone a cloistered attitude on the part of research scientists, although we may regret the withdrawal of able men from reflection on the duties of citizenship. But engineering is as deeply involved in the economic aspects that arise from it as it is in the scientific aspects from which it springs. As individuals we can not control the misuse of our works, but it is a duty of the engineering schools to impartially expound to their students the various economic and social influences that may arise from engineering. We need more clearly defined research into the serviceable and the disserviceable effects that may arise from engineering which springs out of scientific discovery and invention, so that the great populations of the world may better know how to avoid the disserviceable.

In the meantime, it rests with the engineering schools to put before their students the truism that untoward events arise out of human errors, angers, jealousies, vanities, selfishnesses and greeds; while fortunate events arise out of the developed sense of mutuality of interest among individuals and nations—which sense leads to platforms of generous fair dealing. Here is where we are now most deficient in our efforts. The problem of improvement is a difficult one, but I have seen such magnificent improvement in engineering education during the last half-century that I am filled with the optimistic belief that this problem ultimately will be solved.

OBITUARY

JOHN ELIOT WOLFF

The death of Professor John E. Wolff brings to an end a close association and friendship of more than forty years which for the writer of this note has been a major influence in his scientific work. Our acquaintance began in 1895 when he called me to Harvard to help in the reorganization of the mineral collection of which he had recently been made curator. Wolff was conducting courses in petrography and mineralogy in a newly organized department closely associated with the department of geology. Instruction in mineralogy was within a few years placed in my hands, and Wolff devoted himself to petrography and optical mineralogy. His interest in the Mineralogical Museum grew with the years, and he gave a large portion of his time to its improvement. He added to it largely from his private means since it was not at that time endowed. He also provided instrumental equipment for the laboratories and equipped a chemical laboratory where he did quantitative work of great accuracy.

Wolff studied with Rosenbusch in Heidelberg in 1884–85 and was one of the first to teach in this country the then recently developed science of microscopical petrography. He was much in the field in his earlier years: with Shaler in Kentucky; with Pumpelly in the Transcontinental Survey for the Northern Pacific Railway; and as a geologist of the United States Geological Survey, working in western Massachusetts and northern New Jersey. His name appears as co-author with Pumpelly of the monograph describing the Hoosac Tunnel section through the Berkshires, he having done the optical petrography as well as much of the field work for that study.

He took part in the International Geological Congresses of 1900 in France; of 1906 in Mexico; of 1910 in Sweden; and of 1913 in Canada; and from all these trips he brought large and carefully selected collections of rocks for use in his teaching. The big hammers that he carried in order to secure fresh specimens were famous, and other members of these excursions gathered around him to share the results of his spoils.

While in Montana in 1883 on the N.P. Survey he visited the Crazy Mountain group and discovered the peculiar alkali rock-type to which Rosenbusch gave the name *theralite*. He revisited this mountain group twice, mapping and collecting additional specimens of its varied igneous rocks; and all the rest of his life was more or less devoted to the study of this material, his final report appearing in 1938 in the *Bulletin of the Geological Society of America*.

Professor Wolff's most important contribution to the development of the department at Harvard so long in his care was in securing the Holden endowment. Albert F. Holden, who graduated in 1888, was a very successful mining engineer. Early in his professional career he began to collect the minerals found in his mines and ultimately accumulated an important collection. Holden intended his minerals to go to Harvard and therefore kept in close touch with Wolff in order that his collection might supplement rather than duplicate the Harvard cabinet. When in 1913 Holden realized that his career was destined to come to an untimely end through an incurable disease, he conferred with Wolff as to the form and wording of the munificent bequest with which he had determined to endow the Harvard Mineralogical Museum. He died before the end of the year, and his minerals came at once to the university. Professor Wolff, during the next few years, spent all his free time incorporating into the exhibition cases the more striking specimens from Holden's collection.

It was not until eight years after Holden's death that the trustees of his estate were able to turn over to the university the endowment fund. When it had been received in 1922, Wolff decided that the event marked a proper termination of his active service for the museum and the department of mineralogy and petrography. He therefore retired at commencement, 1923, and left to the writer the acceptable task of carrying out the intent of Mr. Holden, to raise the Harvard Mineralogical Museum to an equality with the best, a task made possible by the generous funds provided. Wolff also gave his own considerable estate, subject to a life annuity, to the university in the form of the John E. and Philip Wolff Fund, the income of which, after his death, was to be devoted to the growth and use of the collection to which he had devoted so large a part of his life.

Immediately upon his retirement Wolff sold his Brookline house and removed to Pasadena, California. His letters after settling in the comfortable new home which he established there were full of delighted appreciation of his freedom from routine cares and of the comfort of a mild climate. Always an enthusiastic motorist, he provided himself with a car especially equipped for travel in the desert, and Death Valley became his familiar touring ground during the winter months. He made a special study of the tragic story of the Manley party, first to cross that famous depression, and published a pamphlet on their probable route. It was often his custom to drive there, alone or with a companion, camping by preference near a lonely farm high on the Panamint Range.

Knowing the desert so well from his long experience, it seems unfortunate that he should have set out alone, at his advanced age of 83, in the midst of the summer heat, into the Mojave Desert upon what proved to be his last trip. He was found in his car, which was hopelessly sanded, having died apparently from heat exhaustion after using all his resources to extricate his machine from the desert sands.

Wolff was of a retiring nature, and it was not easy to penetrate his reserve. Those who had lived with him in camp say that there he relaxed and revealed his intense enjoyment of life in the open. Gentle and kindly he was, and his purse was always open to those who needed aid. He was a musician, and after he ceased to be able to play the piano his Victrola became his greatest solace. His house at Pasadena was full of the latest optical and microscopical equipment, which he used up to the time of his death. This is not the place to tell of the domestic afflictions which left him a lonely soul. My last visit with him six months since left me with the sad assurance that he was failing rapidly, and I can not grieve that he died as he did in the open desert wastes which he had grown to love so well.

CHARLES PALACHE

SCIENTIFIC EVENTS

THE FISH AND WILDLIFE SERVICE

PURSUANT to the President's Reorganization Plan No. III, and House Joint Resolution 551, the Bureau of Fisheries and the Bureau of Biological Survey was on June 30 consolidated into a new bureau to be known as the Fish and Wildlife Service. It is believed that this consolidation will provide many advantages to both bureaus, and that it is further evidence of the interest of the Administration in the conservation of fish and wildlife.

A statement made by Charles E. Jackson, assistant director of the Fish and Wildlife Service, is published in *The Fisheries Service Bulletin.* It reads in part:

> Within the span of a few months we have twice been swept into the stream of progress by the President's reorganization plans. Each move has been in the interest of a better program of conservation of national resources, and efficiency of operation in implementing that program. In July, 1939, placed administratively under the guidance of the United States Department of the Interior, we went on to a fuller opportunity for development. With the merging of our forces and those of the Biological Survey, we should find even greater scope for our activities, more ease of movement and better hope for expansion of our services to the country.
>
> The following is a typical example of the many advantages to be gained by the integration of the two bureaus: Supplementing the "91-billion-acre water farm," upon which it has been our task to guide aquicultural activities for the past 7 decades, will be an additional 14 million acres of federally protected wildlife refuge land. A vast portion of this land embraces both fresh- and salt-water areas wherein we may carry out necessary experiments in the conservation of aquatic life. There also are many favorable streams within these areas which may be restocked with fish; thus creating additional recreational areas for sport fishermen. For the first time in our history we shall have fish, as well as game, refuges—a seven-league-boot step in the direction of fishery conservation.
>
> The President's reorganization plans have brought about a renaissance of the bureau in which all our efforts will be augmented by those of a staunch ally whose broader purposes have, like ours, been useful conservation of our country's natural resources.

REPORT OF THE SUB-COMMITTEE OF THE AMERICAN INSTITUTE OF CHEMISTS ON LICENSING OF CHEMISTS IN NEW YORK STATE

A SUB-COMMITTEE of the American Institute of Chemists on the licensing of chemists in New York State has made public its report. The committee consists of Foster D. Snell, *chairman,* Dr. R. E. Kirk and Dr. Maximilian Toch. This committee started the year 1939–40 with a bill which had been drafted the previous year.

The following is a summary of the report:

> The bill was introduced by Senator Esquirol and in the House by another representative, in neither case under the direct sponsorship of The American Institute of Chemists. It was therefore printed on February 7, 1940, as Senate Bill 1111, and at some similar date as a corresponding House bill.
>
> A conference was held by your chairman and Dr. Maximilian Toch with Governor Lehman in regard to this bill. This could be summarized simply to the effect that Governor Lehman stated that he would not sign such a bill even though it were passed by the legislature unless he were advised by the regents that it had their approval.
>
> On February 24 a conference was held with Dr. Milton E. Loomis, associate commissioner for higher education. The summary of some two hours' conversation can be very brief. The bill as drafted would have the opposition of Dr. Loomis, who is in responsible charge of administration of such licensing acts. While he could not, of course, express the opinion of the regents, a definite inference was obtained that the regents would also oppose the bill in the form in which it stood at that time. There grew out of the conference the suggestion that licensing of chemists be handled by permissive legislation parallel to the way in which certified public accountants are registered. A draft of a proposed act pursuant to this suggestion was prepared.
>
> At this point, therefore, the chairman who had been conducting these negotiations personally called a meeting of the licensing committee and presented this proposal to them for action on March 19. The committee on licensure approved the proposed change. It was then presented to the council at a subsequent meeting on the same day and also had the approval of the National Council.
>
> The plan of the future schedule of the bill is as follows. It is expected that the present draft will be carefully gone over for revision by members of your committee during the summer. Fairly early in the fall it should be presented in draft form to Dr. Loomis and the members of the Board of Regents for consideration. As soon as the election is over and before the legislature convenes, it should be presented to the chairman of the Committee on Education in the Senate and in the House for their consideration. It is hoped that it can be arranged that these chairmen will present it as their bill to the 1941 legislature which convenes immediately after the new year. Provided it has their blessing and provided there is no serious opposition, it should pass the 1941 legislature.

The committee has cooperated very closely with Dr. Charles L. Parsons, secretary of the American Chemical Society, in all the above matters in the belief that it was only by cooperation rather than competitive effort that substantial and suitable accomplishment could ensue.

THE COLLEGE OF ENGINEERING OF CORNELL UNIVERSITY AND AMERICAN INDUSTRY

A PROGRAM of cooperation with American industry to train promising young employees as engineers has been announced by Dean S. C. Hollister, of the College of Engineering of Cornell University. The plan will use part of the income from the $2,000,000 John McMullen Scholarship Fund to create John McMullen Industrial Scholarships for apprentices in industry selected by officers of the companies as men whose value would be increased by a college education in engineering. Industries have for many years provided funds for scholarships and fellowships at Cornell and other universities. This program reverses the usual procedure, since the university provides the funds for educating men chosen by industries.

Endorsement of the program has been given by numerous leaders of industry, following the successful experiment worked out with the General Electric Company during the past year. Last September two high-school graduates from the four-year G. E. apprentice training course were awarded McMullen Scholarships of $400 a year, paying full tuition during the four- or five-year courses they chose to pursue. Both have made excellent records in the College of Engineering.

The Board of Trustees has now authorized the award of four such scholarships each year, making an eventual total of at least sixteen. The number may be further increased. Scholarship-holders must be high-school graduates qualified to meet the regular entrance requirements of the college, must have served some time as workers in industry, preferably in a regular training course, and must be recommended by their employers as men of special ability whose careers would be helped by a college course in civil, electrical, mechanical or chemical engineering. It is contemplated that the McMullen Industrial scholars will return to the same organization by which they were previously employed.

In a statement made by Dean Hollister he says:

> The College of Engineering is glad to have such students because they have already demonstrated initiative and a talent for engineering. As men who have acquired skill in the mechanical techniques of industry, they have a practical point of view from which to approach engineering problems professionally. Furthermore, because of their maturity and their practical experience, they have a clearer idea of their own objectives and of the value and meaning of our technical courses. Officers of industrial concerns are glad to recommend their superior apprentices to us, because they know that four or five years of college training in engineering will make them more effective employees. The program is especially beneficial to the students, because it gives them college training at a time when they are best able to assimilate it and use it to qualify for better positions in fields already chosen.

Applications for the four scholarships to be awarded in September are now being received by the college. This new use of the John McMullen Fund, the bequest of the late president of the Atlantic Gulf and Pacific Company, will not diminish benefits received by other students. The College of Engineering is completing the annual selection of more than thirty secondary school seniors from all parts of the country for four- or five-year McMullen Regional Scholarships, and fifteen McMullen graduate scholars have been appointed. In addition, more than fifty students in the three upper classes next year will receive aid through McMullen undergraduate scholarships. One out of every six students in the College of Engineering now receives some sort of aid from this fund, which is continually being increased by the income from stock in the company.

THE PAN-AMERICAN CONGRESS OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Tentative plans for the meeting in Cleveland on October 11 and 12 of the Pan-American Congress of Ophthalmology and Otolaryngology have already been reported in Science.

The first event of the congress will be a joint banquet with the academy on Wednesday evening, October 9, at which Dr. Frank Brawley of Chicago, president of the academy, will preside. On Thursday afternoon, October 10, the official delegates appointed by the various governments will meet with representatives of ophthalmologic societies to draw up a constitution and make plans for future meetings. Official recognition of the congress will be extended by the city of Cleveland at a reception on Friday evening, October 11.

The scientific program will occupy both Friday and Saturday. Papers will be divided equally between speakers from the Latin American countries and those from the United States. Papers in Spanish or Portuguese will be discussed by English-speaking physicians, and those presented in English will be discussed by Latin American speakers. Slides showing a résumé of each paper will be shown on a screen in the two languages other than the one being spoken.

Among those from South American countries who will appear on the program will be:

Dr. Pereira Gomes, chief of an eye clinic at the General Hospital, Saõ Paulo, Brazil.

Dr. Cesario de Ondrade, professor of ophthalmology, Faculdade de Medicina, Cirurgia y Pharmacia, Bahia, Brazil.

Dr. A. Vasquez Barriere, professor of ophthalmology, on the faculty of medicine of the University of Montevideo, Uruguay.

Dr. Carlos Charlin, professor of ophthalmology, University of Santiago, Chile.

Dr. Santiago Barrenechea, assistant professor of ophthalmology, University of Santiago.

In addition, there will be Dr. Arturo Quevedo, Guatemala City; Tomas R. Yanes, Habana, Cuba, editor of the *Revista Cubana de Oto-Neuro-Oftalmiatria;* Rafael Silva, Mexico City, for many years secretary of the Sociedad Mexicana de Oftalmologia y Otorinologia; Manuel U. Troncoso, formerly of Mexico and now of New York, and Manuel Marquez y Rodriguez, formerly a prominent ophthalmologist and teacher in Madrid, now living in Mexico City.

Among those who will discuss papers presented in English will be: Drs. Horacio Ferrer, Habana; Mendonca de Barros and Feliciano Penido Burnier, Saõ Paulo; Heitor Marback, Bahia, and Aniceto Solares, La Paz, Bolivia.

SCIENTIFIC NOTES AND NEWS

Sir Oliver Lodge, who was from 1881 to 1900 professor of physics and mathematics at University College, Liverpool, and from 1900 to 1919 principal of Birmingham University, died on August 22 at the age of eighty-nine years.

Dr. Philip Fox has been requested to resign from the directorship of the Museum of Science and Industry, Chicago, by the newly elected president, Lenox R. Lohr. As has already been recorded in Science, the first action of Mr. Lohr was the summary dismissal of nine of twelve members of the staff, including five of nine curators and others in key positions.

Dr. Charles Packard, of the Institute of Cancer Research at Columbia University, was appointed director of the Marine Biological Laboratory at Woods Hole at the annual meeting of its Board of Trustees. He had been associate director since 1938, and previously had served as clerk of the corporation for seven years. At the corporation meeting, Drs. C. W. Metz, Harold H. Plough and Dugald E. S. Brown were elected members of the Board of Trustees.

The degree of doctor of engineering was conferred on the occasion of the commencement exercises of the South Dakota School of Mines and of the Michigan College of Mining and Technology on John Van Nostrand Dorr, consulting metallurgist, president of the Dorr Company, Inc., of New York City, "in recognition of his contributions to chemical, metallurgical and sanitary engineering practices." Mr. Dorr gave the commencement address at both institutions.

There was recently unveiled in the Mississippi State Chemical Laboratory a bronze tablet that reads in part: "A tribute to William Flowers Hand, scientist, whose unselfish service, tireless energy and devotion to the education of youth of Mississippi and whose distinguished activities as State Chemist merit the naming of this building in his honor." In taking this action the Board of Trustees said that they were grateful "for the fine work that Dr. Hand had done, was doing and would do in the future for the State of Mississippi." Dr. Hand has been professor of chemistry and state chemist for forty years, dean of science for twenty-five years and vice-president of Mississippi State College for six years.

Dr. L. J. H. Teakle, of the Department of Agriculture, Perth, Australia, has recently been elected a fellow of the Australian and New Zealand Association for the Advancement of Science and a member of the National Research Council.

H. W. Swann has accepted the invitation of the Executive Council of the British Association of Supervising Electrical Engineers to continue as president of the association for a further year.

Dr. Donald Price, technical director of the Organic Research Laboratories for the National Oil Products Company of Harrison, N. J., was elected chairman for 1940–41 of the New York Metropolitan Microchemical Society at the ninth regular meeting at Fordham University. Dr. Price succeeds Dr. Alexander Knoll, of Columbia University.

Dr. D. J. Struik, associate professor of mathematics at the Massachusetts Institute of Technology, has been promoted to a professorship.

Dr. Ralph Orlando Freeland, of the department of plant physiology of the Ohio State University since 1931, becomes associate professor of botany at Northwestern University on September 1.

Dr. Hubert R. Hathaway, of the General Hospital of the University of Wisconsin, an expert on anesthesia, has joined the staff of the Medical School of the University of California in San Francisco.

Dr. Earl C. Gilbert, professor of chemistry at the Oregon State College at Corvallis, has been made acting head of the department.

Dr. T. Slater Price has retired from the professorship of chemistry at the Heriot-Watt Technical College, Edinburgh.

Dr. Hans O. Haterius, Wayne University College of Medicine, has been appointed editor of the section on Endocrinology in *Biological Abstracts*. The journal *Endocrinology* will devote the abstract sections of future issues to reporting advances in the field of clinical endocrinology. *Biological Abstracts* will carry abstracts of experimental endocrinology.

Dr. John E. Perry, professor of civil engineering at Cornell University, is again this summer director of Camp Barton, conducted by the Louis Agassiz Fuertes Council, Boy Scouts, on the west shore of Cayuga Lake. This is his fifth season as director.

Following the nomination of Secretary Henry A. Wallace for vice-president of the United States on the Democratic ticket, Claude R. Wickard, under-secretary of agriculture, has been named his successor, and Paul H. Appleby, assistant to Mr. Wallace since 1933, has been named under-secretary.

Dr. Frank N. Freeman, dean of the School of Education of the University of California, has become a member of the Problems and Plans Committee of the American Council on Education.

The Committee on Scientific Research of the American Medical Association has made a grant to Dr.

Rucker Cleveland of the department of anatomy at Vanderbilt Medical School for further research in the field of endocrinology and reproduction.

DR. H. V. S. GRILLO, president of the National College of Agriculture of Brazil, sailed from New York for Rio de Janeiro on August 23. He had spent three months in the United States studying the organization of agricultural institutions.

DR. H. VICTOR NEHER and Dr. William Pickering, of the Massachusetts Institute of Technology, have left Pasadena for an expedition to South Dakota, Oklahoma and Texas to make a further study of cosmic radiation.

A FIELD party headed by Richard K. Mellon, a member of the North American Hall committee of the American Museum of Natural History, left Pittsburgh on August 23 for an expedition to Alaska to collect additional material for the new Osborn Caribou Group now under construction. The party, which includes Mrs. Mellon, will charter a boat at Seattle, cruise along the inland passage along British Columbia and Alaska, and is expected to reach Seward, Alaska, about September 1, from which point the collection of material will commence. Robert H. Rockwell, of the museum staff, is accompanying the expedition as technical adviser. Mr. Rockwell will be principally concerned with gathering flora for the Caribou Group.

THE Glass Division of the American Ceramic Society will meet at Hershey, Pa., on September 6 and 7. There will be technical papers and reports on Friday and Saturday mornings. On Saturday afternoon a golf tournament and visits to points of interest in Hershey have been arranged. In the evening there will be a banquet followed by dancing at the Hershey Park Ballroom.

APPLICATIONS for the Lewis Cass Ledyard fellowship award of the Society of the New York Hospital close on September 15. The income from the fellowship, which was established in 1939, amounts to approximately $4,000, of which $1,000 will be used for supplies and expenses. Preference will be given to younger applicants, who are graduates in medicine and have demonstrated ability to carry on original research of a high order. Applications and correspondence should be addressed to The Committee of The Lewis Cass Ledyard, Jr. Fellowship, The Society of The New York Hospital, 525 East 68th Street, New York, N. Y.

A PLAN which will enable young Central American physicians to take special training at the Medical School of the University of California has been announced. According to the terms of the plan, two young graduate physicians who can speak English will be sent every year by each of the Central American nations for two years' special study in pre-clinical and clinical subjects under the guidance of an advisory committee. The committee, which will consist of Drs. Howard C. Naffziger, professor of surgery; Charles L. Connor, professor of pathology, and Ralph Soto-Hall, clinical instructor in orthopedic surgery, will assist each visiting physician in planning the type of special training which will be most valuable to him. No formal courses will be given. Countries sending representatives include Costa Rica, Salvador, Guatemala, Honduras and Nicaragua.

PRESIDENT WALLACE W. ATWOOD, of Clark University, in cooperation with the staff of the School of Geography, will conduct a graduate seminar during the coming academic year, taking as the special theme: Geography in National Defense. Provided that there is a registration of at least twenty men the School of Geography will offer a special course for undergraduate men, selecting from the various fields of geography those phases of the science that should be incorporated in the training of men who may wish to qualify as officers in the Army or Navy or to go into public service associated with the work of national defense. Certain phases of political geography may be introduced. The course will be evolved as the work proceeds and will be under the general direction of President Atwood.

THE *Journal* of the American Medical Association reports that at a joint meeting of the trustees of the North Carolina Baptist Hospital and of Wake Forest College, on July 18, contracts were let for the new Bowman Gray School of Medicine of Wake Forest College in Winston-Salem and additions to the hospital amounting to $701,572. It is estimated that it will take a year to complete the buildings. The school will also have a fifty-bed hospital which has been leased to it by the Junior League of Winston-Salem for teaching and research in psychiatry. The school will assume responsibility for the professional conduct of the child guidance clinic conducted by the league.

ACCORDING to the *Journal* of the American Medical Association the Illinois State Health Department presented two new exhibits in its annual health exposition at the State Fair in Springfield from August 17 to 25 in cooperation with the Public Service Company of Northern Illinois. One depicted the hazards of night driving and the inability of the eye to cope with these hazards. Dioramas, transparencies, working models, apparatus, street and highway lighting units and the scientific equipment used in research on the subject were shown. The other exhibit showed 2,000 years of progress in the evolution of resuscitation from drowning, gas asphyxiation and electric shock. Dr. Hart E. Fisher, Chicago, chief surgeon of the public service company, was in charge. Other features of the exposition were free blood tests, medical examination of children, exhibits on "contact" diseases and nutrition. A motion picture program was presented daily.

In the British Parliament Sir Thomas Moore recently asked the Minister of Supply whether he could give an assurance that in the limitation of paper supplies due regard would be had for the relative importance of various publications, and that reasonable preference would be given to the requirements of those publishing educational, scientific and technical journals and books. Mr. Harold Macmillan, parliamentary secretary to the Minister of Supply, replied: "While the Minister can not accept the responsibility for introducing in the allocation of the limited supplies of paper anything which might savor of a censorship, due regard will be had to the provision of reasonable amounts of paper for educational, scientific and technical publications."

According to the London *Times* a new government technical school at Takoradi, West Africa, built on 30 acres of grounds at a cost of £37,000 has been opened. The school had to be removed from Accra, partly because the accommodation there was inadequate to meet the growing demand for technical training, partly because the new site is more accessible for the industrialized areas of the Gold Coast. The school overlooks Takoradi harbor and includes a long, single-story workshop with blacksmith's shop, a demonstration block of three stories, with classrooms, laboratories, drawing offices and assembly hall. Over 100 students can be housed in the dormitory block. The workshop provides for instruction in two sections: one for practical work in mechanical engineering, the other for practical woodwork. Both sections are fitted with electrically driven machinery and the usual benches for manual work. Two blocks contain quarters for African masters, and there is a bungalow for a European housemaster. The buildings are grouped around a sports ground of five acres. Most classrooms and the assembly hall are wired for reception of wireless programs from the Sekondi station. Present students include boys from all parts of the Gold Coast.

DISCUSSION

A STANDARD EXPERIMENTAL VEGETATION TYPE

The increasing interest in land with its attendant problems of animal and plant ecology is emphasizing the long-felt need for outdoor and laboratory facilities "where the interactions of land plants and animals and their physiological relations to climate can be studied."[1] In an integrated investigation of this or a related nature, one of the essential parts would be an area sufficiently protected to permit development of the vegetation so as to form a standard and at the same time afford an experiment in itself.

The purpose of adequately protecting a plant cover over a long period can be stated as: What can the two, soil and climate, produce, given certain species of plants, if productivity is not upset by removal of vegetation? We can only guess at the outcome. What will the product be in a definite period of 5, 10 or 15 years or in an indefinitely long period of over 100 years and more? Will development proceed far beyond what we conceive of as the climax for the region? Will it be a more or a less desirable type than the accepted climax, either as forage or as a protective cover for the soil? How will it compare with areas continuously grazed by livestock for the same period and how will it compare with the vegetation on portions of such an area as mentioned by Shelford—"large enough to prevent domestication of plains animals and to be managed on a hands-off basis"?

Without proper protection outdoor studies dealing with the development of vegetation or with competition between plants may be upset at a crucial moment by the destruction of vegetation through one or another of many agencies. Plowing, fire, roadway construction, excessive grazing by livestock and the feeding of rodents or of insects such as grasshoppers or Mormon crickets, all take toll of plots situated in the open ranges and only by chance can a plot be expected to survive intact for long. Elimination of one or a few of the agencies, such as fencing to keep out large animals, may temporarily reduce the destruction of vegetation but it is no dependable solution. The accumulation of plant material on an area surrounded by land where such material is scarce is a stimulus for concentrations or for multiplication of the uncontrolled smaller animals. The resulting damage to the vegetation may be obscure and lead to erroneous conclusions. Sometimes the damage is pronounced. In two 40-acre experimental tracts[2] where fire and grazing had been prevented, jackrabbits suppressed an annual grass in the one, and in the other reduced a sparse vegetation to bare soil.

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[1] V. E. Shelford, Science, 90: 2346, December 15, 1939.

[2] R. L. Piemeisel, U. S. Dept. Agric. Tech. Bull. 654, 1938; also unpublished data.

Some outdoor plant ecological investigations call for a place to work where the removal of vegetation has been reduced to such a low point that the experimenter can safely consider it negligible. The vegetation must remain intact or nearly so. This is not as unreasonable as it may seem at first glance. Fire can be prevented; adequate fencing can keep out the large animals; means of control are known for rodents and for the insects that cause mass destruction of vegetation. It would seem unnecessary to prevent either casual or slight though wide-spread loss such as a leaf or a few leaves taken off individual plants by a leaf-chewing insect or by a plant disease. At what point damage may be disregarded must at the outset be determined by extensive field experience but later may be aided by methods devised to measure and to record damage. Repeated inspections and a series of records for the season should give the amount of damage in any year and it may be hoped that in time the crucial point (at which damage can be considered negligible) may be stated as a definite figure and that control practices as required would become routine. In short, while the ideal would be to prevent all loss of vegetation, practically this is not feasible and perhaps not necessary, so that it is more important that the amount of deviation from the ideal should be known rather than that the minimal loss be prevented.

The question raised in the fore part of this paper, "What can the soil and climate produce?" would obviously be answered best by adequately protecting a community of perennials, one as near to the accepted climax as possible. However, it is equally desirable to adequately protect a vegetation area in a secondary succession stage so as to throw light on the nature and rate of development and also to serve as a comparison to other areas in a similar developmental stage. Moreover, since the early stages of secondary successions are composed of annuals and there is an exceedingly rapid turnover, a generation for each year, such communities are particularly adapted to some such investigations as were suggested by recent studies of semi-desert vegetation.[2] In these it was shown that the removal of vegetation has a pronounced effect on communities of annuals. Thus by preventing excessive removal of vegetation the development of the early stages of secondary successions proceeded from initial weed stages to a third or annual grass stage. But by inducing excessive removal of vegetation (as by enclosed stock) the process was reversed from the third stage to the initial weed stages. Also, by this same method the development was arrested and maintained at the initial weed stage. Although the gross effect of the removal of vegetation is known, a field of investigation is open to measure this effect on communities of annuals in terms of (*a*) number of animals, (*b*) length of time, (*c*) resulting vegetation, the latter measured by comparison with an adequately protected area.

Another important study is suggested by the severe competition and the very rapid turnover in communities of annuals which make them particularly suited to the study of competition in successive generations, that is, to determine the effect of competition in one year or generation and to follow up its results in the next generation and the next and so on. Outdoor statistical studies of such competition are lacking[2] and if carried out under conditions where destruction of vegetation is negligible might lead to the formulation of some fundamental principles underlying competition between plants in general.

In the past, protection has been directed at the elimination of one or more destructive agencies, but so far as the writer is aware there are no long-time records on protected plant communities where loss of vegetation which may have occurred from one cause or another was measured and shown to be negligible. Changes in plant cover on insufficiently protected or wholly unprotected areas can not be ascribed with certainty to differences in physical factors—drought, for instance—if the destruction of vegetation has been disregarded or unmeasured. The marked modifications of communities of annuals previously mentioned were produced, irrespective of any noticeable changes in physical factors such as "wet" and "drought" years, and the development through its stages was induced, was halted or was reversed merely by manipulating the removal of vegetation, that is, by preventing removal or by producing excessive removal. Since within specified limits we can mold communities of annuals as we wish, to what extent can we mold communities of perennials if given a proportionately long time?

Steenis[3] asks, "Is there any undisturbed vegetation on earth?" Whether we agree or disagree with him, the question remains a challenge to show by measurements in any particular region either that there has been no disturbance, or how much has occurred. Measurements can be obtained if there are "standard" vegetation types for comparison. The large tract mentioned by Shelford, and already referred to, should afford one kind of standard if it were maintained for a sufficiently long time so as to approach a natural balance between plants and animals. Another standard should be an area such as is here proposed, adequately protected and maintained for a long period. In short, in the former we would have a plant cover resulting from a "natural" removal of vegetation, in the latter, one resulting from the least possible removal of vegetation. Both of these could then be compared with other plant covers that had been used or treated in various ways under controlled conditions as well as under the existing land-use practices of to-day. From this we could in time obtain a series of values and so arrange a scale, for example, with bare soil as zero, then somewhat higher, the heavily-grazed type, and near the upper end, the standard types just mentioned.

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[3] C. G. G. J. Steenis, *Bull. du Jardin Botanique.* Serie III, Vol. XIV, December, 1936.

In time such values would afford a basis for recommendations regarding sound land-use practices. How can we determine better the part that physical factors —drought, for instance—play and the part that destruction of vegetation (including disturbance caused by man) plays than by attempting to reproduce, through experiment, the effects we see and believe we understand? However, to achieve this there must be some standard for comparison.

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THE MUSEUM AS A POTENTIAL FORCE FOR SOCIAL ENLIGHTENMENT

ONE of the primary functions of the museum is that of education. Thus the schools usually have their children visit the museum more or less regularly, and the public at large is generally also permitted this privilege without charge. Considering the adult population primarily, several questions come to mind. First, assuming that a fair proportion of the adult community has been to the museum once, one wonders how many of this group *revisit* the exhibits and at what intervals? Second, what do the visitors actually see when visiting the museum, and how much of what is seen is remembered? And third, of what significance does it all seem to the general run of visitors?

I am not acquainted with the literature on museum administration, and research based on the above queries may already be available. In any case, my own observations (and the response of a number of other individuals with whom the subject has been discussed support these views), point to the following conditions: (1) Relatively very few in the community visit the museum (*i.e.*, the exhibits) more than once a year, if that often. (2) When the museum is visited, the usual thing is to try and see everything, and since observing all the exhibits in even a single hall in a large museum is physically fatiguing, an excursion through the whole museum is generally an exhausting experience. Indeed, as a result of these latter two considerations, the usual visit to the museum can scarcely be more than a superficial survey, at best. (3) With respect to significance of the exhibits, the attitude of the vast majority of the visitors would probably be that they were all curious and very interesting—but little more.

If the above observations are substantially correct, it seems to me difficult to escape the conclusion that the museums have in large measure failed to make any considerable or lasting impression on the thought or mores of the community at large.

It is not my purpose to belittle the cultural advantages of the modern museum of natural history. On the contrary, this note is prompted by the belief that the museum can and should be a definite and potent influence for tolerance and understanding among peoples, and the following suggestions are proposed with that end in mind.

In order to get the people, and by people I mean folk from all walks of life, not merely the "educated" groups, to come to the museum often and regularly, the exhibits should be imbued with *movement*, which tends to attract and hold the interest. Thus, the fascinating story of man's biological history, his ethnological and cultural differentiation, and the like, could be told by means of moving and talking pictures, in serial fashion, just as the modern planetarium each month relates a different chapter in the story of the heavens. As in the planetarium, also, the visitors would be seated comfortably for the "show," and the factor of fatigue would be eliminated. The latter, as well as the fact that attention would be focused on one exhibit story, and over a long period of time, should be conducive to retention of what was seen and heard. Perhaps of most importance, however, is that each science thus presented, and especially the anthropological and social sciences, could and must be intelligently related to the present, everyday world of the people witnessing the exhibits: otherwise, as now, the response would probably be mere esoteric interest. For example, combined with the exhibits and explanation of the material or social culture of the American Indian would also be an account of their contributions to our present mode of living, and what is more, how similar the fundamental drives and sanctions were for them as for us to-day, albeit expressed more or less differently as a result of another day and culture, a discrepancy which should also be noted with reference to our own behavior in the course of time.

It should also be noted that our great museums serve the large urban centers primarily. True, in these days of relatively easy travel, many persons from all over the country get to visit the large cities at one time or another, and these may go to the museum. However, there are probably millions of others in our rural sections of the country who have never had the opportunity of attending a good museum even once. Yet the cultural treasures of the greatest museums could be brought to all the people, in rural as well as in urban communities, by means of motion pictures.

Most of us tend to think of the present as having always been with us, and our social intelligence is apt to be limited if not warped in consequence. Effective demonstration through the medium of motion pictures of the relative recency of most of our customs and beliefs should perforce tend to broaden perspective and tolerance among peoples. Finally, the barrier of language-differences could be surmounted in motion pictures (using sub-titles when necessary), thereby also enhancing social intercourse and understanding. In short, it is my contention that motion-talking pictures, intelligently utilized by the museum, could make the museum a great force for social as well as intellectual enlightenment.

The practical question of financing such an undertaking as proposed is probably the most serious obstacle in its path, whether an insurmountable one or not, I do not know.

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ELECTRODES SEALED IN GLASS TUBING

GARRETT, Hogge and Heiks[1] have noticed erratic potentials in the use of platinum electrodes sealed in glass tubing. The source of trouble was located at the glass-metal-solution interface. They did not mention the type of glass used. Some years ago I noticed that platinum electrodes sealed in Pyrex glass gave very poor results in the titration of ferrous sulfate with dichromate, or the reverse.[2] On finding that electrodes made with soft glass behaved satisfactorily, I abandoned the Pyrex and had no further trouble. While erratic behavior in some cells may be attributable to this cause, there is evidence that junctions of soft glass and platinum can at least sometimes be immersed in solutions without erratic results. For example, some lead-iodine cells in which platinum electrodes were sealed in soft glass by means of lead-glass seals and immersed in a paste of lead iodide, iodine and electrolyte were found unusually reproducible.[3] It seems that the immersion of a platinum-glass interface does not invariably lead to erratic results, and further light on the source of trouble and how to avoid it would be welcome.

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SCIENTIFIC BOOKS

PHYSICS

Classical and Modern Physics, A Descriptive Introduction. By HARVEY E. WHITE. 707 pp. New York: D. Van Nostrand and Company. 1940. $3.75.

IT is doubtless a truism that teaching is yet an art and the art of an individual teacher. Be the educational objective ever so clearly defined the good teacher must and will follow his own procedure, irrespective of whether others agree or can follow in his path or not. To anyone who has had recourse to the admirable pictorialization of the atoms and their spectra presented in White's "Introduction to Atomic Spectra" it will be obvious that in his more elementary presentations this author must employ to an even greater extent his very clear and vivid graphical and visual methods. The perfection of the text-book on review is thus the expression of the art of the author in his attempt to solve a teaching problem. The task set is not an easy one. The problem of presenting a stimulating one-semester survey course in physics of collegiate grade interesting alike to students who have or who have not taken high-school physics is no mean task.

The objectives which the author sets himself to accomplish are as follows: "First to start as nearly as possible at the beginning of each subject, second to develop each new concept or phenomenon so that a student with some knowledge of the simplest principles of algebra and plane geometry should have no difficulty in following; and third to adequately illustrate each subject and chapter with diagrams and photographs."

In each of these the author quite successfully accomplishes his mission. The presentation of the classical physics must in the nature of the objectives be brief, but the essentials are all there. The style is terse and crisp. The physics is excellent and the illustrations are adequate. The few equations presented are not too difficult and the numerical examples of solutions of these equations facilitate the student's understanding. At times one feels that unnecessarily many examples of some less important principles are given, (*e.g.*, optical illusions), but in general no example of an important principle capable of ready pictorialization has been omitted. In reading the book one wishes that there were a bit more discussion of the subjects in some of the earlier chapters and particularly that more attempts were made to correlate and connect the various chapters and sections. For in reality the whole of classical physics is bound together by the Newtonian system. The failure to do this gives the reader the impression that physics consists of a confusingly great number of relatively unrelated facts, which in a survey course is most unfortunate. It is in this respect that the reviewer most questions the value of the purely pictorial mode of approach. In part, of course, this lack of coordination is the consequence of the necessary condensation of the topic. Perhaps the weakest chapters are those on electrical phenomena, owing undoubtedly to the great difficulty which one has in depicting the involved nature of electrical phenomena especially without adequate space in which to develop the concepts. Both this section and that on light suffer in that they tend to stress the *applications* of the phenomena perhaps too much at the expense of the fundamental concepts.

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[1] A. B. Garrett, E. Hogge and R. Heiks, SCIENCE, 92: 18, 1940.

[2] W. C. Vosburgh, *Jour. Am. Chem. Soc.*, 44: 2155, 1922.

[3] W. C. Vosburgh and V. H. Dibeler, *Jour. Am. Chem. Soc.*, 61: 2522–2523, 1939.

Concerning the presentation of the modern physics the author states as follows: "The treatment of modern physics here is given more or less in its historical development. Wherever feasible the presentation of each new subject includes first a brief historical account of the discovery, second an experimental demonstration of the phenomenon, third a discussion of practical applications accompanied by one or more experiments, and fourth a brief account of the accepted theory and its experimental confirmation." In this later procedure the author is far more successful in the second half of the book than in the first, for more space is allotted to the development of each topic. For a book of this type the text is remarkably free from the dogmatism that can so readily creep into such a text.

The drawings are exceptionally fine, and the make-up and printing of the book are excellent. The short biographical sketches of the various contributors to physics appearing as footnotes are a most fortunate addition. As a whole the book is conventional enough to be widely used in survey courses, while its original and vivid, yet dignified pictorialization lends it an air differing quite markedly from the usual college texts.

Leonard B. Loeb

SMASHING ATOMS

Why Smash Atoms? By Arthur K. Solomon. 174 pp. Cambridge: Harvard University Press. 1940. $2.50.

Of the many books attempting to popularize modern physical advances this book presents an interesting innovation: In the first place it confines itself to a limited field, *viz.*, atomic disintegration. In the second place it strives to lay an adequate scientific background for the discussion before attempting it. In clear, simple and elegant English it develops a layman's picture of the atom and its constituents, proceeding in a logical and somewhat historical manner. This being accomplished in the first fifty pages, the author then proceeds to discuss nuclear transmutations and smashing devices, as well as the detecting instruments used. In the third portion of the book in some 30 pages the results of nuclear reactions, including uranium fission, are presented. The applications of the nuclear disintegrations to medicine and other fields are also briefly given. The presentation of the principles of high energy particle production, as well as the difficulties of cyclotron operation with which the author is familiar, are particularly good. The author must, however, be congratulated in general for the facility of presentation of scientific material to the lay public which is in evidence throughout.

To the reviewer who grew up with the development of this subject and who, together with Marsden in 1919, was the first to check the artificial disintegration of N by α-particles in Rutherford's laboratory before the results were published, the liberties taken by the author with scientific history are particularly irritating. In a measure some of these difficulties are to be ascribed to the author's avowed policy, "I have deliberately omitted the names of many whose work is fundamental to nuclear physics, not because I do not appreciate the nature of their contributions, but for the more practical reason that too many names would confuse the reader." Whether this confusion would result or not were more names included is in itself highly debatable. Leaving this aside, however, there is no justification whatsoever for bringing Franklin's name preeminently into the fundamentals of the early discoveries of static electricity. Much as we revere our Franklin, his contributions to the subject were negligible except for proposing the single fluid theory of electricity. The implication to an uninstructed public that these advances were due to Franklin is most misleading. Either *no* names should have been mentioned or *more* names should have been mentioned. Misconceptions of this character are frequently invoked in sections of the book. There are other errors of omission equally annoying, such as the omission of all mention that prior to Moseley in 1913 the concept of nuclear charge and atomic number had clearly been put forward by Van den Broek, Soddy and Fajans on the basis of the chemistry of the radio elements. The descriptions in the first portion of the book are clarified through the use of simple but unnecessarily crude line drawings. One wonders, however, why the dignity of an otherwise good lay presentation of a scientific subject must be marred by irrelevant animal cartoons such as the black and white birds on page 37, representing α and β-particles supposedly emitted in the uranium series. On the other hand, the photographs of the various sources of high energy particles as well as those of cloud tracks are among the best so far reproduced in texts. It would, however, have been better for the reader if more accurate descriptions of these figures could have been embodied in and correlated with the text. Aside from these marring features the book constitutes a real contribution to the popularization of modern physics.

LEONARD B. LOEB

PHYTOPATHOGENIC VIRUSES

Handbook of Phytopathogenic Viruses. By FRANCIS O. HOLMES. vii + 221 pp. Minneapolis: Burgess Publishing Company. 1939. $2.00.

THE virous nature of certain diseases of plants has been known since 1892, when Iwanowski described the filterable nature of tobacco mosaic which Beijerinck confirmed in 1898 and interpreted as being a "contagium virum fluidum." Since then many virous diseases of plants have been described, and numerous attempts have been made to roughly classify them.

The present effort of Dr. Holmes to bring out an orderly presentation of these diseases carries far beyond any previous attempt at nomenclatorial classification. He has adopted the Linnean system in common use for the higher biologic forms, applying Latin binomials for virous names. He has also applied common names in accordance and has included the recognized vulgar synonyms.

The author has included as separate entities in this work 129 viruses of seed plants which he considers to be sufficiently distinctive to deserve specific binomial or trinomial designation. In addition he has described under Latin binomials those bacteriophages which can be recognized as distinctive.

Specifically this work treats only those virous entities known to attack plants, including bacteria, under the division Phytophagi. This division is separated into two classes, Schizophytophagi and Spermatophytophagi. The former embraces one family, Phagaceae, in which 40 bacteriophagic species and two varieties are recognized under one genus *Phagus*, of which the type is *P. minimus* (Bacteriophage S13 of the colon and dysentery bacteria).

The Spermatophytophagi contains ten families based largely on symptoms produced on typical host plants.

Family 1. Chlorogenaceae, which is typified by *Chlorogenus callistephi*, the aster yellow virus. The author recognizes nine species and five varieties in this genus.

Family 2. Marmoraceae likewise contains one genus *Marmor* with 53 species and 26 varieties, of which *M. tabaci*, the tobacco mosaic virus, is the type. This largest family contains the more commonly recognized virous diseases which produce mottling or mosaic symptoms.

The remaining eight families are small but distinctive. The Annulaceae embraces four species and three varieties characterized as the ringspot family, of which *Annulus tabaci* causing tobacco ringspot is the type. The Gallaceae or Fiji-disease group with four species is characterized by vascular proliferations of which *Galla Fijiensis* causing Fiji disease of sugar-cane is the type. The Acrogenaceae (spindle-tuber group); Rugaceae (leaf-curl group); Coriaceae (leaf-roll group); Nanaceae (dwarf-disease group) complete the families of the Spermatophytophagi. Each species is treated in a systematic manner under synonyms, suscepts, immunes, geographical distribution, induced disease, transmission, serology, immunology, thermal inactivation, filterability, other properties such as crystallization, sedimentation, molecular weights, etc., control and literature.

The two supplements contain respectively a list of susceptible and insusceptible plants and a list of viruses not treated in the book and about which too little is known for classification. The work is concluded with an adequate index.

The author has stepped out and given his colleagues in the virous field a conception of these entities which must be taken seriously. Whatever is the final decision regarding the nature of viruses, his method of classification is certainly scientific and will appeal to those of us who can not remember whether aucuba-mosaic virus is the same as tobacco virus 6 and nicotiana virus 10. Furthermore, Dr. Holmes has brought together in a convenient form the most accurate information extant on these most interesting and important entities and thus has performed a real service to phytopathology.

As a novelty the book is lithoprinted and loose-leaved and has a spiral metal binding which opens flat, with cardboard covers.

C. R. ORTON

WEST VIRGINIA UNIVERSITY

PLANT MICROTECHNIQUE

Plant Microtechnique. By DONALD A. JOHANSEN. xi + 523 pp. New York: McGraw-Hill Book Company. 1940. $4.50.

THIS is the most extensive review of microtechnical methods as applied to botanical materials that has yet appeared, at least in English. In addition to the space devoted to the more familiar problems of fixation, dehydration, imbedding, sectioning, staining and the preparation of whole mounts, one chapter discusses with satisfying fullness the recently developed smear methods, and another outlines some of the most useful microchemical manipulations. More than 200 pages are devoted to a systematic discussion of special details of culture, preservation for morphological purposes and the cytological treatment of members of all the plant groups from Schizophyta to Anthophyta.

The book, as the preface points out, does not attempt the impossible task of being encyclopedic. In the course of the necessary selection, the author has chosen methods either because they are widely used or because they have shown their value in tests made by him or under his supervision. Dr. Johansen's experience and his well-known contributions to technique guarantee the value of his recommendations. It is true, of course, in a field in which experience varies so greatly and in which success is dependent upon so many uncontrollable factors, including the personal one, that any experienced technician will find reason to question some of the author's conclusions and to regret certain of his omissions. However, granting limitations of space, no one writer probably could have made a better selection.

The subject-matter is presented clearly and fully enough to be usable by a beginner. On the other hand, so much is included and so many useful hints as to detail are presented that the book will be of value to all workers in its field, however extensive their experience. The author has given us an important and a thoroughly up-to-date contribution.

C. E. ALLEN

THE UNIVERSITY OF WISCONSIN

REPORTS

COOPERATIVE INVESTIGATIONS OF THE RELATION BETWEEN MOSQUITO CONTROL AND WILDLIFE CONSERVATION[1]

SINCE the creation of the Tennessee Valley Authority in 1933, the Tennessee River has been converted into a series of large reservoirs. This change from river to lake conditions has necessitated certain major biological readjustments within the area. These adjustments concern not only the valuable wildlife and fisheries of the region, but create potential hazards to the health of man, particularly with regard to increased production of anopheline mosquitoes capable of transmitting malaria. Although these attendant changes are not unique to the Tennessee Valley, but have occurred, or will occur, in other large impoundments in the South, nevertheless the Authority has felt obligated to investigate the possible conflict between malaria control procedures and wildlife conservation.

On February 28, 1939, a meeting was held in Knoxville, Tennessee, which was attended by representatives of the Federal Bureau of Biological Survey, Public Health Service, Bureau of Fisheries, Bureau of Entomology and Plant Quarantine, and departments of the TVA interested in wildlife conservation and mosquito control. A second meeting was held on May 8. After full discussion of mutual interests, a Technical Committee was appointed to carry on a cooperative field study to obtain information on the nature and extent of the effect of mosquito larvicides and of water-level fluctuation upon fish and waterfowl, or upon their food supply; to consider possible substitution or modification of practices where damage was established; and to provide a mechanism for the coordination of the interests of the participating agencies. Representatives of the interested state agencies were invited to participate.

Members of the Technical Committee investigated the various problems jointly in the field, chiefly in Wheeler Reservoir,[2] during the summer of 1939. The continuous fluctuation of the water-level for anopheline control, together with the "over-all" fluctuations for flood control, navigation and other purposes, rendered it extremely difficult to separate the exact influence of these factors from one another and from other malaria control procedures. Variation of water-level results in the invasion of species of vegetation adaptable to such conditions. Certain of these species are undesirable, both from the viewpoint of wildlife conservation and malaria control. Wide variation of water-level inhibits the growth of submerged vegetation and of most of the indigenous emergent species of high value for waterfowl. Fluctuation also has a marked effect upon the qualitative and quantitative distribution of aquatic organisms.

Studies were conducted on the influence upon aquatic fauna and flora of the routine use of Paris green (applied by airplane at the rate of about one pound per acre) for the control of the malaria mosquito, *Anopheles quadrimaculatus.* These treatments showed no deleterious effect upon vegetation, and gave no evidence of a catastrophic destruction of aquatic organisms important as fish food. The great variability of conditions and the complicating factors in the experimental areas rendered these studies extremely difficult. For these reasons the data were inadequate to measure partial changes in the fauna which may have resulted. Chemical analyses of soil samples showed that arsenical residues accumulate in the bottom of the reservoirs in variable amounts.

In a general study, extending beyond the limits of the Tennessee Valley, on the effect of various poisons upon the physiology of fishes, representatives of the Bureau of Fisheries, working more or less independently of the studies of the Technical Committee, showed that, while arsenic accumulates in the fish of TVA reservoirs, the quantities stored to date in fishes are insufficient to be a menace to human consumption. This study is being continued to evaluate any additional storage which may develop. However, fish from these reservoirs gave evidence of disturbed metabolism, resulting possibly from malaria-control measures or other operations of the project.

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[1] Report of the Technical Committee, May 14, 1940.

[2] A wildlife refuge was established in this reservoir by executive order, in August, 1938.

Attention was also given to the effect of larvicidal oil (4 parts kerosene and 1 part black oil) as used routinely for mosquito control during 1939. Comparisons were made with kerosene (plus a dye as a marker) and with pyrethrum larvicide. The three materials showed similar results in that their deleterious effect was chiefly confined to the amphipods, of which a large proportion was destroyed. The larvicidal oil was toxic to vegetation when applied in excessive quantities, but resultant damage was more or less of a temporary nature, except that there was some evidence to indicate a tendency toward prevention of seed formation. Kerosene appeared to be the toxic constituent.

At a meeting of the participating agencies in Chattanooga, Tennessee, on February 28, 1940, it was agreed that the joint field study had resulted in the coordination of interests and that it should be continued during the summer of 1940. Investigations to be included are: (1) the relation of various species of aquatic vegetation to the production of *A. quadrimaculatus;* control of species of vegetation inimical to mosquito control and wildlife interests; and experimental plantings of species of vegetation desirable for wildlife propagation and relatively innocuous in mosquito production, (2) the biological influence of fluctuation of water-levels, (3) the source, rate of accumulation and the form in which arsenical residues occur in the bottom of the reservoir and the toxicity of these residues to aquatic fauna and flora, (4) the direct influence of Paris green and larvicidal oil on fish life, (5) natural predators of anopheline larvae, (6) the utilization of such supplementary malaria-control procedures as dykes, low-head dams, screening and mosquito-proofing; the restriction of land use to daytime occupation, and (7) new mosquito larvicides.

E. L. Bishop,
Chairman, Policy Committee

SPECIAL ARTICLES

PANTOTHENIC ACID AND NUTRITIONAL ACHROMOTRICHIA IN RATS

Depigmentation of the fur, so-called "graying" in black and piebald animals and "rusting" in albino animals, can be produced with great regularity in rats fed a vitamin B-free basal diet (casein 18 per cent., sucrose 68, melted butterfat 8, cod liver oil 2, salt mixture 4) supplemented with thiamine, riboflavin and vitamin B_6 in an amount of 20 micrograms of each daily.[1-4] If the diet is devoid of vitamin B_6, this syndrome is less frequently observed, owing probably to the phenomenon of competition of vitamin-deficiency diseases—a B_6 deficiency *versus* lack of the anti-gray-hair factor.[5]

It has been shown[4] that purified but still crude concentrates of pantothenic acid with a degree of purification varying up to 50 per cent. had a definitely curative effect on this nutritional achromotrichia in rats. Thus it has been concluded that these concentrates contained a specific factor concerned in the cure of depigmentation of the pelt. This factor has been found to be heat labile; autoclaving of an alkaline solution destroyed the activity of the concentrates.

Although the parallelism between biological activity and grade of purification as well as heat lability of pantothenic acid favored the assumption that the specific anti-gray-hair factor is identical with pantothenic acid in the concentrates tested, the corresponding final conclusion had to be deferred until the experiments could be repeated with pure pantothenic acid.

Recently Nielsen, Oleson and Elvehjem[6] have reported the isolation of a crystalline substance which, when fed at 15 micrograms per rat per day, prevented achromotrichia. This substance was different from pantothenic acid. These authors point out that "the factor preventing nutritional achromotrichia should be clearly differentiated from pantothenic acid."

With the production of synthetic pantothenic acid,[7] sufficient amounts of the pure substance became available[8] for the study of its activity in nutritional achromotrichia in rats.

A large number (30) of rats suffering from deficiency of pantothenic acid with its different manifestations[4, 9] was treated with graduated doses of pantothenic acid. In this group 12 piebald and black animals were included, 6 of which had localized and 6 more extensive, generalized achromotrichia. The therapeutic effect of pantothenic acid on the depigmentation of the fur was prompt and definite. With the administration of daily doses of from 75 to 100

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[1] P. György, *Biochem. Jour.*, 29: 741, 1935.

[2] A. F. Morgan, B. B. Cook and H. G. Davison, *Jour. Nutrition*, 15: 27, 1938.

[3] G. Lunde and H. Kringstad, *Zeit. Physiol. Chem.*, 257: 201, 1939.

[4] P. György, C. E. Poling and Y. SubbaRow, *Jour. Biol. Chem.*, 132: 789, 1940.

[5] P. György and H. Goldblatt, *Jour. Exper. Med.*, 70: 185, 1939.

[6] E. Nielsen, J. J. Oleson and C. A. Elvehjem, *Jour. Biol. Chem.*, 133: 637, 1940.

[7] R. J. Williams and R. T. Major, Science, 91: 246, 1940.

[8] Synthetic pantothenic acid was generously put at our disposal by Merck & Co., Inc., Rahway, N. J.

[9] P. György and R. E. Eckardt, *Nature*, 144: 512, 1939.

micrograms the bluish discoloration of the skin due to the first growth of normally pigmented hair shafts in the epidermis was noticed in from 5 to 7 days; with lower doses (50 micrograms), later. The appearance of the black fur then made rapid progress and the cure was practically complete with higher doses (75 to 100 micrograms) in from 5 to 7 weeks. In rats fed lower doses (50 micrograms), the cure was incomplete but the effect was still pronounced.

In summary, the statement appears to be warranted that pantothenic acid has a definitely curative effect on nutritional achromotrichia in rats fed a diet free from pantothenic acid.

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CRYSTALLINE VITAMIN A PALMITATE AND VITAMIN A ALCOHOL

THE preparation of crystalline vitamin A alcohol was first reported by Holmes in this journal.[1] From methyl alcohol yellow crystals were obtained, melting at 5–6° C, with an extinction coefficient at 328 mμ ($E^{1\%}_{1cm}$) of 2,000. Later Mead[2] repeated the preparation by Holmes's method and confirmed the melting point. Mead noted, however, that the crystals were not solvent free and suggested that solvent of crystallization might be present. This is to be noted in view of our findings. Extinction coefficients of 1800 and 1820 were found for the solvent-free A alcohol.

In this laboratory the need has long been recognized for a crystalline, natural ester of vitamin A suitable for use in correlating the spectrophotometric and biological assay of vitamin A, that is, in determining the conversion factor. It is now well established that vitamin A occurs in fish-liver oils, the chief source, esterified with long chain fatty acids. Tischer[3] has furthermore shown that vitamin A palmitate is one such ester. We, therefore, chose to make vitamin A palmitate, esterifying crystalline vitamin A alcohol to obtain the purest ester possible. This work has resulted in the preparation not only of the first crystalline fatty acid ester of vitamin A (so far as we know) but also of crystalline vitamin A alcohol, which melts much higher than hitherto reported.

In the preparation of vitamin A alcohol rich fish-liver oils were distilled in a cyclic molecular still. Distillates with extinction coefficients at 328 mμ of 400 or greater were combined and saponified, yielding vitamin A alcohol concentrates with extinction coefficients of 1,100–1,300. These usually crystallized readily, sometimes after redistillation, from their 10 per cent. solution in ethyl formate at −35° C. after sterols had been removed. After drying in a vacuum at low temperature, pale yellow prismatic crystals of vitamin A alcohol were obtained which were solvent free and melted at 63–64° C. Propylene oxide has also been used as a crystallizing solvent.

Vitamin A alcohol crystallized twice in this way has an average extinction coefficient at 328 mμ of 1,725. This is the average of eighteen preparations, some with extinctions measuring as high as 1,850. The average extinction coefficient at 328 mμ calculated from the blue value was slightly lower, namely, 1,700.

The ultraviolet absorption was measured with a Hilger quartz spectrograph, model E-498, with a Spekker ultraviolet photometer. Antimony tri-chloride blue values were determined with an Evelyn colorimeter standardized with a distilled vitamin A concentrate whose extinction coefficient had been repeatedly determined and checked by the non-saponifiable matter from U.S.P. reference oil.

The extinction coefficient of the vitamin A alcohol blue color with antimony tri-chloride was also determined using a Hardy recording spectrophotometer. The average value found was $E^{1\%}_{1cm}$ (622mμ) = 4700. Special precautions were taken to evaluate the transitory blue color at its maximum intensity.

Vitamin A palmitate was prepared by esterifying crystalline vitamin A alcohol with palmityl chloride and quinoline in chloroform solution at −15° C. The crude ester crystallized readily from a 2 per cent. solution in propylene oxide at −30° C, in pale yellow plates, m.p. 26–28° C.

After two crystallizations vitamin A palmitate has an average extinction coefficient of 940. The average extinction coefficient at 328 mμ calculated from the blue value was 933. This value of 940 corresponds to an extinction coefficient of 1,720 for vitamin A alcohol.

The extinction coefficient of the antimony trichloride blue color with crystalline vitamin A palmitate was found to be 2490 at 620 mμ. By calculation this gives a value of 4560 for vitamin A alcohol which is 3 per cent. lower than the value found by measurement for the crystalline alcohol.

Our value for the extinction coefficient of vitamin A alcohol is about 1,720, whether obtained by assaying the crystalline alcohol or by calculation from the extinction of the crystalline palmitate. This is about 4 per cent. lower than the value of 1,800 recorded by Mead from the assay of crystalline vitamin A alcohol and two esters, the anthraquinone-2-carboxylate and the 2-naphthoate. We do not exclude the possibility that our preparations are impure, but it seems more probable that the difference is due to a slightly different spectrophotometric technique and the use of different instruments.

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[10] S.M.A. Corporation fellow in biochemistry, assigned to the Department of Pediatrics.

[1] H. N. Holmes, SCIENCE, 85: 103, 1937.

[2] T. H. Mead, *Biochem. Jour.*, 33: 589, 1939.

[3] A. O. Tischer, *Jour. Biol. Chem.*, 125: 475, 1938.

Since the high-melting vitamin A alcohol and the crystalline palmitate present possibilities for biological research and the standardization of vitamin A preparations, it is important that their stability under various conditions be known. We have made preliminary storage tests on the palmitate, distilled esters from a fish-liver oil, vitamin A 2-naphthoate (kindly supplied by Dr. T. H. Mead) and beta carotene, the present international standard, and found that they are equally stable in refined cottonseed oil at comparable concentrations when exposed to air in the dark. The crystalline vitamin A palmitate decays more rapidly than the naphthoate on exposure to air. It is hoped to make a further report on the stability of these materials.

A preliminary biological assay of the crystalline vitamin A alcohol has shown that its potency is greater than 2,700,000 U.S.P. units per gram. It is planned to determine the biological potency of both crystalline vitamin A alcohol and crystalline vitamin A palmitate as precisely as possible. The results will be reported separately.

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THE EFFECT OF SALICYLATE ON THE OXYGEN UPTAKE OF THE TUBERCLE BACILLUS

UNLIKE most other bacteria the tubercle bacillus does not readily oxidize carbohydrates, amino acids, hydroxy acids, etc., when these substances are added to suspensions in the Warburg apparatus. As shown in Fig. 1, the addition of 1.0 mg of sodium salicylate (o-hydroxybenzoate) to the bacteria suspended in 2.0 cc of M/20 phosphate buffer pH 6.7 more than doubles the oxygen uptake. A corresponding increase in CO_2 production also occurs. The bovine strain B_1 was used. It was grown on beef glycerine infusion broth and the floating masses were removed with a loop and suspended in sterile saline in Hopkins tubes. These were then centrifuged at 2,000 r.p.m. for 15 minutes and the saline replaced by sterile buffer, so that 0.1–0.2 cc of the packed bacteria were suspended in 1.0 cc of buffer. A glass rod the diameter of which was just smaller than the narrow part of the Hopkins tube broke up the cell masses and gave an even suspension. Fig. 1 shows that benzoate also has an effect on the oxygen uptake. On the other hand, p- and m-hydroxybenzoates and methyl salicylate are without action, as is acetylsalicylate until the acetyl group has been hydrolyzed off. p-aminobenzoate has no action and o-aminobenzoate only a slight one, but when the latter is added with salicylate it inhibits the salicylate effect. o-aminosulfonic acids have not yet been tried.

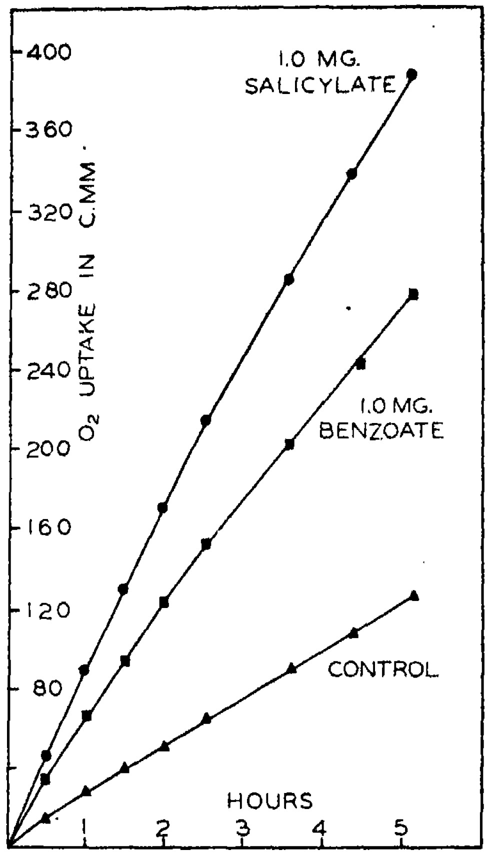

FIG. 1. The oxygen uptake of 0.5 cc of the suspension of tubercle bacilli alone and with salicylate and benzoate at pH 6.7 and 37° C.

When 0.1–0.2 mg of salicylate is used the oxygen uptake is proportional to the concentration, indicating that the salicylate is being oxidized as a substrate. No definite end-points were obtained. The results do not prove that salicylate is a normal metabolite of the tubercle bacillus but suggest that it or compounds of similar configuration may be important. The fact that p-aminobenzoate has been shown to be a metabolite of certain streptococci[1] indicates that substituted benzoates may play a part in bacterial metabolism.

FREDERICK BERNHEIM
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NORNICOTINE AS THE PREDOMINATING ALKALOID IN CERTAIN TOBACCOS

NICOTINE has long been considered the main alkaloid of *Nicotiana tabacum*, ordinary tobacco. This view is based upon the finding of Pictet and Rotschy,[1] in 1901, that only 2.5 per cent. of the total tobacco alkaloids was other than nicotine. For the tobacco of their time, and for most commercial tobaccos of to-day, this percentage can probably be accepted as typical.

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[1] D. D. Woods, *Brit. Jour. Exp. Path.*, 21: 74, 1940.

[1] Amé Pictet and A. Rotschy, [Paris] *Acad. des Sci. Compt. Rend.*, 132, 971–2, 1901.

In recent years, however, tobacco breeders have been cultivating low-nicotine strains in an effort to produce milder smoking tobacco. From one such experimental lot of Maryland tobacco there has been isolated, in amount equal to 95 per cent. of the total alkaloids, a base identified as nornicotine. This base had previously been found in tobacco as a minor alkaloid constituent, and it had also been found in other species of *Nicotiana* as the main alkaloid. For example, C. R. Smith[2] found that it constituted about 95 per cent. of the alkaloids of *N. sylvestris*. The occurrence of nornicotine as the predominating alkaloid of *N. tabacum* appears to be a hitherto unrecognized fact. Whether there is an association between low-nicotine strains and nornicotine can not be definitely asserted, but there is some reason for believing that nature compensates for the repression of nicotine by synthesizing the closely related parent alkaloid.

Not only structurally, but also pharmacologically, the two are similar. As a contact insecticide against the bean aphid (*Aphis rumicis* L.), dl-nornicotine was more toxic than dl-nicotine, and about as toxic as l-nicotine.[3] The naturally occurring forms are laevorotatory in both cases, but no insecticide tests with l-nornicotine are known, probably because of its scarcity. Against animals the action of nornicotine was weaker, in one case being only one tenth that of nicotine.[4] From the smoker's standpoint this is fortunate.

The possibilities of nornicotine as a stomach poison against insects have not been explored, chiefly because of its unavailability. Now that the existence of a strain of tobacco containing it has been discovered, it is hoped to prepare a supply of this alkaloid for such tests.

L. N. MARKWOOD

BUREAU OF ENTOMOLOGY AND
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SCIENTIFIC APPARATUS AND LABORATORY METHODS

TATOO PUNCH FOR NUMBERING RATS

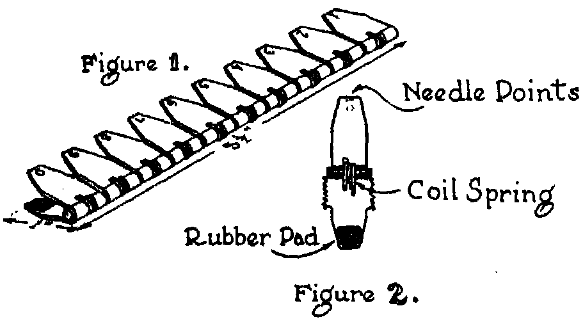
PERSONS handling large experimental colonies of pedigreed albino rats usually invent some personal system of hole-punching or edge-snipping of their rats' ears, which symbols plus sex and cage number may be referred to a ledger to identify the specimens.

But tame albino rats usually face out and become both quiet and inquisitive as one approaches their cage. Making use of this inborn trait, a great deal of time and effort can be saved if one is able to read the individual ledger number of each rat directly in his ears at a glance without even opening the cage door.

In order to be able to do just this, some technicians spend much time in laboriously tatooing the ears of all their rats by means of a needle and India ink. At least 15 minutes is spent on each animal at the time of weaning. This procedure solves the problem admirably, but it is too wasteful of time.

We report here the construction of a handy tatooing punch for rats, which we have tested and found to be satisfactory. It consists of a base plate of sheet metal, 1″ × 5½″ in dimensions, serrated with 10 teeth on one side and hinged on the other side.

Ten small number plates (½″ × 1″) are hinged to the base plate in parallel, as shown in Fig. 1. The number plates are normally held away from the base plate by means of small coil springs. On the serrations of the base plate (Fig. 2) are thin rubber pads. On the inside of the number plates opposite the rubber pads are soldered fine needle points so arranged as to outline numerals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0.



FIGS. 1 and 2.

In tatooing rats' ears, one must be sure that the needles go clear through the pinna, and it is well to brush India ink into the holes on both sides to insure the best results. The rubber pad that receives the needle points insures that they pass completely through the ear.

Thus, to employ the tatoo punch properly the operator takes the punch in his right hand, inks the number desired by means of a stubby watercolor paint brush, grasps in his left hand the rat to be numbered, and with the index finger and thumb of the right hand closes the appropriate numeral plate firmly on the rat's ear so that the inked needles pass through the ear and their tips penetrate the rubber pad. By releasing pressure the punch springs open. The operator then dabs the protruding needle points and removes the punch, at which time the needle points carry ink back into the holes as they are being withdrawn. Finally the operator brushes both sides of the ear vigorously in order to work the ink deeply into all the needle holes.

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[2] C. R. Smith, *Jour. Econ. Ent.*, 30: 724–727, 1937.

[3] C. H. Richardson, L. C. Craig and T. R. Hansberry, *Jour. Econ. Ent.*, 29: 850–5, 1936.

[4] A. Bergwall, quoted by M. Ehrenstein, *Arch. der Pharm.*, 269: 627–59, 1931.

The chief difficulty encountered in preparing such a tatooing device is to have the needles fine enough and numerous enough that when a rat is tatooed at 3 weeks of age, the tatooed points will not separate enough to distort the numeral during subsequent growth of the pinna, because later the numbers increase about ⅓ both in length and breadth.

Likewise the numerals must be small enough that at least two of them may be placed side by side in each ear.

By using two numbers in each ear one may distinguish up to 10,000 individuals and by employing three numbers one may continue the series up to 1,000,000.

CLYDE E. KEELER

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A TESTED METHOD OF GROWING STENTOR COERULEUS

THE heterotrich protozoan *Stentor coeruleus* is valuable for many laboratory purposes but is difficult to maintain in culture. Several attempts were made to grow it according to methods described in the literature (Hetherington[1]; Turner,[2] Brandwein[2]), but none of these produced a satisfactory supply of specimens. Finally, a standard method was developed which has yielded specimens in abundance for more than a year. The method is described in the following paragraph:

Gallon jars are nearly filled with spring water, and to each is added 10 cc of an extract of lettuce, prepared by boiling 10 grams of fresh lettuce leaves in 100 cc of distilled water until about 50 cc has been evaporated. After 12 to 24 hours the water begins to appear cloudy due to bacteria. Then specimens of *Stentor coeruleus* and *Chilomonas paramecium* are put into the jars. Every few days, when the water shows signs of becoming clear, fresh lettuce extract is added. Whenever (usually two to four weeks) the stentors begin to multiply less rapidly, new cultures are started by transferring some stentors and chilomonads from the old cultures to jars of new medium. The jars are kept at room temperature in light of very low intensity or in darkness.

It is not known whether the stentors depend mainly for food upon the chilomonads or upon the bacteria. It is known, however, that the chilomonads are ingested readily. Rotifers which may be present in the cultures seem to cause no trouble, but paramecia must be kept out because they consume the bacteria so quickly that the stentors are deprived of their food supply.

The jars must be kept in light of low intensity or in darkness to prevent the excessive growth of unicellular green algae. Even in moderate light the algae gradually cause the culture medium to become green. If this condition is approached the stentors must be transferred to fresh medium.

No more than 10 cc of lettuce extract may be added to a jar at one time because an excess will cause bacteria and yeast cells to increase so much that the culture becomes too acid. The hydrogen-ion concentration of the cultures must remain between pH 6.2 and pH 7.8. These limits will ordinarily not be exceeded if the bacteria do not become too numerous.

Some difficulty may be experienced from the growth of aquatic fungi. The stentors tend to become entangled in the mycelia of these molds, making it difficult to remove them without injury. By stirring the cultures vigorously every few days, the mycelia are dislodged from the sides of the jars and settle to the bottom, where they cause no further trouble. If no lettuce infusion is added for some time, the stentors accumulate in the mats of mycelia on the bottom of the jars, but if more lettuce infusion is added they again collect near the surface of the water.

If it is desired simply to maintain a culture of stentors with a minimum of effort, fresh lettuce leaves may be put into the culture jars. But if this is done the stentors attach to the leaves. The advantage of using an extract of lettuce is that the stentors attach to the sides of the jars near the surface, whence they can be easily removed with a pipette.

W. H. BELDA
W. J. BOWEN

THE JOHNS HOPKINS UNIVERSITY

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[1] A. Hetherington, *Archiv. für Protistk.*, 76: 118–129, 1932.

[2] J. P. Turner and P. Brandwein, "Culture Methods for Invertebrates," pp. 60 and 64. Ithaca, N. Y.: Comstock Publishing Company.

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RADIOACTIVITY[1]

By the late SIR JOSEPH (JOHN) THOMSON, Master of Trinity College, Cambridge

I now pass to a very brief consideration of one of the most important and interesting advances ever made in physics, and in which Canada, as the place of the labors of Professors Rutherford and Soddy, has taken a conspicuous part. I mean the discovery and investigation of radioactivity. Radioactivity was brought to light by the Röntgen rays. One of the many remarkable properties of these rays is to excite phosphorescence in certain substances, including the salts of uranium, when they fall upon them. Since Röntgen rays produce phosphorescence, it occurred to Becquerel to try whether phosphorescence would produce Röntgen rays. He took some uranium salts which had been made to phosphoresce by exposure, not to Röntgen rays but to sunlight, tested them, and found that they gave out rays possessing properties similar to Röntgen rays. Further investigation showed, however, that to get these rays it was not necessary to make the uranium phosphoresce, that the salts were just as active if they had been kept in the dark. It thus appeared that the property was due to the metal and not to the phosphorescence, and that uranium and its compounds possessed the power of giving out rays which, like Röntgen rays, affect a photographic plate, make certain minerals phosphoresce, and make gases through which they pass conductors of electricity.

Niepce de Saint-Victor had observed some years before this discovery that paper soaked in a solution of uranium nitrate affected a photographic plate, but the observation excited but little interest. The ground had not then been prepared, by the discovery of the Röntgen rays, for its reception, and it withered and was soon forgotten.

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[1] Concluding portion of the address of the president of the British Association for the Advancement of Science, given at Winnipeg in 1909. Reprinted from the issue of Science for August 27, 1909. Sir Joseph Thomson died on August 30.

Shortly after Becquerel's discovery of uranium, Schmidt found that thorium possessed similar properties. Then Monsieur and Madame Curie, after a most difficult and laborious investigation, discovered two new substances, radium and polonium, possessing this property to an enormously greater extent than either thorium or uranium, and this was followed by the discovery of actinium by Debierne. Now the researches of Rutherford and others have led to the discovery of so many new radioactive substances that any attempt at christening seems to have been abandoned, and they are denoted, like policemen, by the letters of the alphabet.

Mr. Campbell has recently found that potassium, though far inferior in this respect to any of the substances I have named, emits an appreciable amount of radiation, the amount depending only on the quantity of potassium, and being the same whatever the source from which the potassium is obtained or whatever the elements with which it may be in combination.

The radiation emitted by these substances is of three types known as α, β and γ rays. The α rays have been shown by Rutherford to be positively electrified atoms of helium, moving with speeds which reach up to about one tenth of the velocity of light. The β rays are negatively electrified corpuscles, moving in some cases with very nearly the velocity of light itself, while the γ rays are unelectrified, and are analogous to the Röntgen rays.

The radioactivity of uranium was shown by Crookes to arise from something mixed with the uranium, and which differed sufficiently in properties from the uranium itself to enable it to be separated by chemical analysis. He took some uranium, and by chemical treatment separated it into two portions, one of which was radioactive and the other not.

Next Becquerel found that if these two portions were kept for several months, the part which was not radioactive to begin with regained radioactivity, while the part which was radioactive to begin with had lost its radioactivity. These effects and many others receive a complete explanation by the theory of radioactive change which we owe to Rutherford and Soddy.

According to this theory, the radioactive elements are not permanent, but are gradually breaking up into elements of lower atomic weight; uranium, for example, is slowly breaking up, one of the products being radium, while radium breaks up into a radioactive gas called radium emanation, the emanation into another radioactive substance, and so on, and that the radiations are a kind of swan's song emitted by the atoms when they pass from one form to another; that, for example, it is when a radium atom breaks up and an atom of the emanation appears that the rays which constitute the radioactivity are produced.

Thus, on this view the atoms of the radioactive elements are not immortal, they perish after a life whose average value ranges from thousands of millions of years in the case of uranium to a second or so in the case of the gaseous emanation from actinium.

When the atoms pass from one state to another they give out large stores of energy, thus their descendants do not inherit the whole of their wealth of stored-up energy, the estate becomes less and less wealthy with each generation; we find, in fact, that the politician, when he imposes death duties, is but imitating a process which has been going on for ages in the case of these radioactive substances.

Many points of interest arise when we consider the rate at which the atoms of radioactive substances disappear. Rutherford has shown that whatever be the age of these atoms, the percentage of atoms which disappear in one second is always the same; another way of putting it is that the expectation of life of an atom is independent of its age—that an atom of radium one thousand years old is just as likely to live for another thousand years as one just sprung into existence.

Now this would be the case if the death of the atom were due to something from outside which struck old and young indiscriminately; in a battle, for example, the chance of being shot is the same for old and young; so that we are inclined at first to look to something coming from outside as the cause why an atom of radium, for example, suddenly changes into an atom of the emanation. But here we are met with the difficulty that no changes in the external conditions that we have as yet been able to produce have had any effect on the life of the atom; as far as we know at present the life of a radium atom is the same at the temperature of a furnace as at that of liquid air—it is not altered by surrounding the radium by thick screens of lead or other dense materials to ward off radiation from outside, and what to my mind is especially significant, it is the same when the radium is in the most concentrated form, when its atoms are exposed to the vigorous bombardment from the rays given off by the neighboring atoms, as when it is in the most dilute solution, when the rays are absorbed by the water which separates one atom from another. This last result seems to me to make it somewhat improbable that we shall be able to split up the atoms of the non-radioactive elements by exposing them to the radiation from radium; if this radiation is unable to affect the unstable radioactive atoms, it is somewhat unlikely that it will be able to affect the much more stable non-radioactive elements.

The evidence we have at present is against a disturbance coming from outside breaking up of the radioactive atoms, and we must therefore look to some process of decay in the atom itself; but if this is the case, how are we to reconcile it with the fact that the expectation of life of an atom does not diminish as the atom gets older? We can do this if we suppose that the atoms when they are first produced have not all the same strength of constitution, that some are more robust than others, perhaps because they contain more intrinsic energy to begin with, and will therefore have a longer life. Now if when the atoms are first produced there are some which will live for one year, some for ten, some for a thousand, and so on; and if lives of all durations, from nothing to infinity, are present in such proportions that the number of atoms which will live longer than a certain number of years decrease in a constant proportion for each additional year of life, we can easily prove that the expectation of life of an atom will be the same whatever its age may be. On this view the different atoms of a radioactive substance are not, in all respects, identical.

The energy developed by radioactive substances is exceedingly large, one gram of radium developing nearly as much energy as would be produced by burning a ton of coal. This energy is mainly in the α particles, the positively charged helium atoms which are emitted when the change in the atom takes place; if this energy were produced by electrical forces it would indicate that the helium atom had moved through a potential difference of about two million volts on its way out of the atom of radium. The source of this energy is a problem of the deepest interest; if it arises from the repulsion of similarly electrified systems exerting forces varying inversely as the square of the distance, then to get the requisite amount of energy the systems, if their charges were comparable with the charge on the α particle, could not when they start be further apart than the radius of a corpuscle, 10^{-13} cm. If we suppose that the particles do not acquire this energy at the explosion, but that before they are shot out of the radium atom they move in circles inside this atom with the speed with which they emerge, the forces required to prevent particles moving with this velocity from flying off at a tangent are so great that finite charges of electricity could only produce them at distances comparable with the radius of a corpuscle.

One method by which the requisite amount of energy could be obtained is suggested by the view to which I have already alluded—that in the atom we have electrified systems of very different types, one small, the other large; the radius of one type is comparable with 10^{-13} cm., that of the other is about 100,000 times greater. The electrostatic potential energy in the smaller bodies is enormously greater than that in the larger ones; if one of these small bodies were to explode and expand to the size of the larger ones, we should have a liberation of energy large enough to endow an α particle with the energy it possesses. Is it possible that the positive units of electricity were, to begin with, quite as small as the negative, but while in the course of ages most of these have passed from the smaller stage to the larger, there are some small ones still lingering in radioactive substances, and it is the explosion of these which liberates the energy set free during radioactive transformation?

The properties of radium have consequences of enormous importance to the geologist as well as to the physicist or chemist. In fact, the discovery of these properties has entirely altered the aspect of one of the most interesting geological problems, that of the age of the earth. Before the discovery of radium it was supposed that the supplies of heat furnished by chemical changes going on in the earth were quite insignificant, and that there was nothing to replace the heat which flows from the hot interior of the earth to the colder crust. Now when the earth first solidified it only possessed a certain amount of capital in the form of heat, and if it is continually spending this capital and not gaining any fresh heat it is evident that the process can not have been going on for more than a certain number of years, otherwise the earth would be colder than it is. Lord Kelvin in this way estimated the age of the earth to be less than 100 million years. Though the quantity of radium in the earth is an exceedingly small fraction of the mass of the earth, only amounting, according to the determinations of Professors Strutt and Joly, to about five grams in a cube whose side is 100 miles, yet the amount of heat given out by this small quantity of radium is so great that it is more than enough to replace the heat which flows from the inside to the outside of the earth. This, as Rutherford has pointed out, entirely vitiates the previous method of determining the age of the earth. The fact is that the radium gives out so much heat that we do not quite know what to do with it, for if there was as much radium throughout the interior of the earth as there is in its crust, the temperature of the earth would increase much more rapidly than it does as we descend below the earth's surface. Professor Strutt has shown that if radium behaves in the interior of the earth as it does at the surface, rocks similar to those in the earth's crust can not extend to a depth of more than forty-five miles below the surface.

It is remarkable that Professor Milne from the study of earthquake phenomena had previously come to the conclusion that rocks similar to those at the earth's surface only descend a short distance below the surface; he estimates this distance at about thirty miles, and concludes that at a depth greater than this the earth is fairly homogeneous. Though the discovery of radioactivity has taken away one method of calculating the age of the earth it has supplied another.

The gas helium is given out by radioactive bodies, and since, except in beryls, it is not found in minerals which do not contain radioactive elements, it is probable that all the helium in these minerals has come from these elements. In the case of a mineral containing uranium, the parent of radium in radioactive equilibrium, with radium and its products, helium will be produced at a definite rate. Helium, however, unlike the radioactive elements, is permanent and accumulates in the mineral; hence if we measure the amount of helium in a sample of rock and the amount produced by the sample in one year we can find the length of time the helium has been accumulating, and hence the age of the rock. This method, which is due to Professor Strutt, may lead to determinations not merely of the average age of the crust of the earth, but of the ages of particular rocks and the date at which the various strata were deposited; he has, for example, shown in this way that a specimen of the mineral thorianite must be more than 240 million years old.

The physiological and medical properties of the rays emitted by radium is a field of research in which enough has already been done to justify the hope that it may lead to considerable alleviation of human suffering. It seems quite definitely established that for some diseases, notably rodent ulcer, treatment with these rays has produced remarkable cures; it is imperative, lest we should be passing over a means of saving life and health, that the subject should be investigated in a much more systematic and extensive manner than there has yet been either time or material for. Radium is, however, so costly that few hospitals could afford to undertake pioneerink work of this kind; fortunately, however, through the generosity of Sir Ernest Cassel and Lord Iveagh a Radium Institute, under the patronage of his Majesty the King, has been founded in London for the study of the medical properties of radium, and for the treatment of patients suffering from diseases for which radium is beneficial.

The new discoveries made in physics in the last few years, and the ideas and potentialities suggested by them, have had an effect upon the workers in that subject akin to that produced in literature by the Renaissance. Enthusiasm has been quickened, and there is a hopeful, youthful, perhaps exuberant, spirit abroad which leads men to make with confidence experiments which would have been thought fantastic twenty years ago. It has quite dispelled the pessimistic feeling, not uncommon at that time, that all the interesting things had been discovered, and all that was left was to alter a decimal or two in some physical constant. There never was any justification for this feeling, there never were any signs of an approach to finality in science. The sum of knowledge is at present, at any rate, a diverging not a converging series. As we conquer peak after peak we see in front of us regions full of interest and beauty, but we do not see our goal, we do not see the horizon; in the distance tower still higher peaks, which will yield to those who ascend them still wider prospects, and deepen the feeling, whose truth is emphasized by every advance in science, that "Great are the Works of the Lord."

THE ORIGIN OF THE EARTH'S LAND FORMATIONS

By Dr. C. D. PERRINE

ARGENTINE NATIONAL OBSERVATORY, CORDOBA

The peculiar and very irregular distribution of the land and water areas of the earth's surface as well as their forms and constitutions have attracted attention since man has known of their existence as such. Explanations to account for some of these conditions have been made from time to time, but none has been wholly satisfactory and for some no explanation has been attempted. The object of this note is to put on record the chief points of a general theory which occurred to me some years ago, and which appears to explain satisfactorily a number of observed facts. It is recognized that the difficulties in the way of substantial proofs are very great. For this and other reasons of scientific caution, the hypothesis is presented tentatively for further study and future confirmation or rejection. It is my belief, however, that, in general and radical as it is, it will be confirmed, because some of the evidence is of considerable weight and I have so far found none which is prohibitory.

Several years ago, the principal points known at that time were placed (on a general invitation) at the disposal of a group interested in the progress of science and its dissemination, but as far as I know nothing has yet been published on the subject. These and other details will be given in a full discussion of the hypothesis which it is planned to publish if my impaired health permits.

The theory rests upon the possibility that the earth was bombarded in some past age by a meteoric swarm or swarms which came from a southerly direction. When the explanation first suggested itself, no facts were known which could throw light on this all-important point, the suggestion coming solely from two well-marked peculiarities of continental and mountain formation, *viz.*, the accumulation of land in the higher northern latitudes with a complementary deficiency in the southern hemisphere, and the appearance of the Indian Peninsula and the Himalayan mountain ranges which give the impression of having been thrust northward into the Asiatic Continent. These suggested a force acting from the south. Later, the fact occurred to me that far the larger number of craters on the moon were in its southern hemisphere.

It is now generally accepted that such "craters" could have been formed by the impact of meteors. If, therefore, these "craters" or a considerable number of them, were formed in that way, the assumption is permissible that the earth may have been, and almost certainly was, bombarded in a similar manner. These circumstances provide the possibility of such meteoric action as could bring about the observed conditions.

Briefly, aside from the above, the principal observed facts and their bearing are as follows:

(1) The large land excess in the northern hemisphere and a corresponding deficiency in the south.

(2) The broadening out toward the equator of the continental areas from their pointed southern extremities and still more in the far northern regions where they form an almost continuous ring about the polar ocean.

(3) An open polar ocean and surrounding land mass in the north, and a continental land mass surrounded by water about the south pole.

(4) Generally greater elevations of the land above sea-level near the southern extremities of the continents than in their northern portions. This is especially noticeable in South America, Africa, Asia and, to some extent, in North America.

(5) Low-lying and frequently marshy or desert areas of great extent in the northern and wider portions of the continental masses.

(6) Carboniferous deposits in these basins, including forests.

(7) As already mentioned, the peculiar appearance of the Indian Peninsula and the Himalaya Mountains to the north. If we look at a contour map of those regions we find the Himalayas folded around the northern and broad part of the Indian Peninsula in just such a manner as is conceivable if the triangular peninsula had been thrust into the Asiatic Continent from the south where we now find the extensive Indian Ocean.

(8) The distances from the South Pole of South America, Africa, India and Greenland all pointed at the southern end, are roughly in the inverse order of their size.

(9) During the Gondwana period the flora (Glossopteris) of India differed greatly from that of Europe but was strikingly similar to the contemporaneous flora of South America, South Africa and Australia.

(10) The southern portions of the South American and African continents are, in general, less temperate than corresponding latitudes in the north.

(11) No secular change in latitude has been established, at least for the continental areas of the northern hemisphere.

(12) Observed earthquake displacements in California, the Philippines and Japan show a relative movement of the continental areas on both sides southward with respect to the Pacific Basin.

(13) It is fairly well established by direct evidence that the earth's crust underneath the great ocean beds is of considerably greater specific gravity than the crust of the continental areas.

(14) The (average) specific gravity of meteorites composing such a swarm may vary from that of stone—say two and one half, to that of iron—say seven.

(15) If, as is usually assumed, the planetary bodies were originally, like the sun, in a gaseous or liquid state, they should remain more or less homogeneous on solidifying, and the present large differences of specific gravity require explanation.

The above are the observed facts for which an explanation is required.

The following hypothesis outlines the course of events and the results which are conceived to have succeeded an encounter of the earth with a swarm or swarms of meteorites. It is assumed that the meteorites came from a southerly direction—not necessarily exactly in the direction of the pole, that they were numerous and that many of them were of considerable size. A single large meteor is not considered capable of having produced the observed effects.

If any considerable part of these meteors was of the heavy metallic type, we have at once a cause for the greater specific gravity of the earth's crust under the oceans. But such an assumption as to specific gravity is not necessary to the general action of such meteor streams because the ordinary stone meteorites are quite sufficient.

Coming from any direction within, say, 30° or 40° of the South Pole, such streams of meteorites could be expected to exert a pressure upon the earth's crust which would depress it where the pressure was normal to the surface, that is, in the regions more or less adjacent to the pole, and elsewhere to "sweep" the surface layers along toward the equator. The known fact that the earth is not perfectly rigid but slightly elastic, and the observed folding of the rock strata are sufficient evidence that such changes can take place. The indications are that these changes have taken place slowly rather than suddenly.

As a further result of such "sweeping" action we can conceive of the land accumulations in the northern hemisphere as formed in a way similar to the snow or sand drifts in the lee of an obstruction, the equatorial bulge acting as such an obstruction.

An alternative, slightly different conception, but one which is simpler and perhaps more probable, is that instead of heavy meteors being responsible for the greater specific gravity of the crust under the oceans, the "sweeping" process has affected only the lighter layers near the surface, pushing these northward and elevating them above the sea-level, thus exposing heavier layers deeper down. A fact favoring this conception is that the average specific gravity of the entire earth is approximately twice that of the continental masses. It may be that both conceptions are involved.

In a preliminary note it is neither necessary nor feasible to discuss in detail the bearing of the proposed hypothesis on all the different observed peculiarities which have been noted above. In most cases a possible bearing is obvious at a glance, which is enough for the present. That some of these relations are apparent rather than real and that not all will be confirmed, is to be expected. The hypothesis is too radical and too many factors are involved to permit of more than tentative acceptance for careful examination. There appears, however, to be no reason known at present for concluding that some such origin is impossible.

SCIENTIFIC EVENTS

THE BIOLOGICAL RESEARCH INSTITUTE OF THE ZOOLOGICAL SOCIETY OF SAN DIEGO

HOUSED in the hospital and laboratory building of the Zoological Society of San Diego is the Biological Research Institute, whose facilities, research opportunities and two research fellowships have been discussed in a recent number of this journal.[1]

Two out of some thirty applicants have been advised of their election to the two fellowships. Jackson S. Kiser, graduate student at the University of Washington, will pursue at the Biological Research Institute studies of food infection in animals, for work toward the doctor's degree from the University of California at Los Angeles. Lawrence R. Penner, Ph.D., 1940, University of Minnesota, will conduct comparative parasitological investigations. Both these men began their work on September 1.

In addition to the conducting of careful and complete *post-mortem* examinations of all animals which die in the zoo and of many wild animals which are brought in from the outside, dead from natural causes, special hospitalization is given to a great variety of animals maintained in the zoo. Investigations concerning nutritional requirements and especially the parasitic diseases of various animals, are in progress, and an early extension of such studies is planned.

Dr. Charles R. Schroeder, veterinary pathologist in charge of the hospital and laboratory; Dr. Carlton M. Herman, a visiting investigator; and Willis Doetschman, a graduate student in the University of Southern California, are conducting research in various phases of animal parasitology. Dr. Herman's present investigations are concerned with life-cycles of certain worm parasites of seals and other animals. Mr. Doetschman is conducting a survey of internal parasites of captive animals, in partial fulfillment of the requirements for a master's degree. Several voluntary workers and a number of students from San Diego State College on a special National Youth Administration project are carrying out technical and statistical investigations under the direct supervision of Dr. Schroeder.

The Research Committee of the institute, who give their counsel and other assistance without compensation to students and research workers are the following: *Protozoology:* Dr. Rawson J. Pickard, San Diego (chairman); *Pathology:* Dr. Howard A. Ball, San Diego; *Biochemistry:* Dr. Denis L. Fox, assistant professor of marine biochemistry, Scripps Institution of Oceanography of the University of California, La Jolla; *Surgery:* Dr. Hall G. Holder, San Diego; *Ophthalmology:* Dr. George L. Kilgore, San Diego; *Physiology:* Dr. Eaton M. MacKay, director of research, Scripps Metabolic Clinic, La Jolla; *Cardiology:* Dr. Francis M. Smith, Scripps Metabolic Clinic, La Jolla; *Dental Pathology:* Dr. Quintin M. Stephen-Hassard, La Jolla; *Microbiology:* Dr. Claude E. ZoBell, assistant professor of marine microbiology, Scripps Institution of Oceanography of the University of California, La Jolla.

The committee appointed to supervise the research conducted under the fellowships consists of the following members of the Research Committee: Drs. Pickard (chairman), Ball, Fox and ZoBell.

DENIS L. FOX

THE GREAT SMOKY MOUNTAINS NATIONAL PARK

THE Great Smoky Mountains National Park was dedicated at Newfound Gap by President Roosevelt on September 2.

The park is almost equally in the states of North Carolina and Tennessee, on the crest of the Great Smokies. Newfound Gap is on the boundary line, where the park's one trans-mountain road crosses.

Harold L. Ickes, Secretary of the Interior, presided at the dedication exercises, and Governor Clyde R. Hoey, of North Carolina, and Governor Prentice Cooper, of Tennessee, made brief addresses. These were followed by the dedicatory address of the President.

The Great Smoky Mountains National Park is one of the units of the Federal Park System administered by the National Park Service "for the benefit and enjoyment of the people." It may be visited any day in the year. During 1939, 760,000 persons entered the park to motor over the modern highways or to travel afoot or on horseback over the 500 miles of trails.

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[1] SCIENCE, 92: 55, 1940.

Authority for establishment of the park was contained in the act of Congress approved May 22, 1926. In 1930 it was established, in a limited way, for protection and administration only, in accordance with Congressional approval of such limited park status upon the acquisition by the government (by donation) of 150,000 acres of land.

Most of the funds to purchase the lands within the approved boundaries were secured by donation. Contributions of citizens of North Carolina and Tennessee and appropriations by the legislatures of those two states raised approximately half the estimated cost of acquiring the required lands. John D. Rockefeller, Jr., through the Laura Spelman Rockefeller Memorial, offered to match contributions up to $5,000,000, in memory of his mother. Because of bank failures during the depression, which wiped out some donations, and of the inability of many to redeem their pledges through the same cause, and also because of rising land values, difficulty was met in securing all the land necessary to establish the park. President Roosevelt in 1933 allotted $1,500,000 of emergency funds, and Congress appropriated $743,265.20 to acquire the last remaining lands.

A short time ago a Founders Memorial Plaque, with the following inscription, was erected at Newfound Gap in the heart of the park:

> For the permanent enjoyment of the people this park was given one half by the people and states of North Carolina and Tennessee and by the United States of America and one half in memory of Laura Spelman Rockefeller by the Laura Spelman Rockefeller Memorial founded by her husband, John D. Rockefeller.

THE MARINE BIOLOGICAL LABORATORY AT WOODS HOLE

AN article in *The Collecting Net* gives an account of the annual meeting of the Corporation and Trustees of the Marine Biological Laboratory, by Dr. Charles Packard, director of the laboratory. At this meeting twelve new members of the corporation were elected as follows:

Dr. H. G. Albaum, Brooklyn College; Dr. C. A. Angerer, Ohio State University; Dr. F. A. Brown, Northwestern University; Dr. Leon Churney, University of Pennsylvania; Dr. G. Failla, Memorial Hospital, New York; the Reverend J. A. Frisch, Canisius College; Dr. F. A. Hartman, Ohio State University; Dr. Marie Hinrichs, Illinois Southern State Teachers' College; Columbus O'D. Iselin, Harvard University, Rockefeller Institute; Mrs. Rebecca Lancefield, Rockefeller Institute; Dr. Floyd Moser, University of Pennsylvania, and Dr. Eric Wald, Harvard University.

Trustees elected by the corporation were:

Dugald E. S. Brown, New York University; H. B. Bigelow, Harvard University; R. Chambers, New York University; W. E. Garrey, Vanderbilt University; S. O. Mast, the Johns Hopkins University; A. P. Mathews, University of Cincinnati; C. W. Metz, University of Pennsylvania; H. H. Plough, Amherst College; W. R. Taylor, University of Michigan.

Drs. Caswell Grave, R. G. Harrison and C. E. McClung, trustees who have reached the age of seventy years, were elected trustees emeriti.

Memorials to the following members of the corporation who have died were read:

Dr. H. McE. Knower, for many years librarian of the laboratory (read by R. G. Harrison).

Dr. M. M. Metcalf, trustee since 1897 (read by R. A. Budington).

Dr. Charles Zeleny, well remembered by the older investigators (prepared by F. Payne).

Captain John Veeder, for fifty years connected with the laboratory, in charge of the boats until his retirement (read by F. R. Lillie).

Discussion at both the meeting of the trustees and of the members of the corporation centered about the new addition to the library, now actually under construction. Dr. Packard states that the necessary funds for its erection have been given by the Rockefeller Foundation, which some years ago aided in the construction of the Brick Building. The new structure, 59 x 51 feet in outside dimensions, will have the same height and architectural style as the present building. The four tiers of stacks, corresponding to the present stack floors, will provide space for almost twice as many volumes as there are on hand at present. On all floors reading tables will be provided. On the upper two floors there will be a generous amount of space between the tables and the stacks, so that readers should not be disturbed by those who are moving about in the stacks. A part of the basement will be used for the sterilization of glassware, distillation of water and other services requiring steam. Two dark rooms are also provided.

THE DETROIT MEETING OF THE AMER- AT WOODS HOLE

As has already been reported in SCIENCE, sessions of the American Chemical Society will open at Detroit on September 9 and will last through the week.

At two o'clock on Monday the first general session will be held in the Scottish Rite Cathedral of the Masonic Temple. The program will include the presentation of the Women's Award to Dr. Mary Engle Pennington and the presentation of the American Chemical Society Award in Pure Chemistry to Lawrence Olin Brockway. Dr. M. L. Crossley, of the American Cyanamid Company, will make an address at this session on "Certain Aspects of the Chemistry of Infectious Diseases" and Dr. Per K. Frolich, of the Standard Oil Development Company, an address on "Butyl Rubber—a New Hydrocarbon Product." The last address on the program is the presidential address of Dr. S. C. Lind, dean of the Institute of Technology of the University of Minnesota, who had taken as his subject "Chemistry within the Atom."

The session will be followed by a tea, and at nine o'clock there will be a reception and dance at the Masonic Temple.

Dr. Charles F. Kettering, vice-president of the General Motors Corporation, who is honorary chairman of the local committee, will give the address at a subscription dinner on Wednesday evening at seven o'clock. At ten o'clock on the same evening there will be a complimentary dance in the ballroom of the Hotel Statler.

Technical sessions of the various divisions of the society are planned for each day. There have been arranged numerous group luncheons, dinners and a large number of excursions to the industrial plants of the city, especially those illustrative of the major phases of automobile manufacture.

The University of Michigan will act as host for an all-day trip. The party will divide according to interests to inspect the following laboratories:

Physical Chemistry, Physics. Surface chemistry, adsorption, interfacial tension, adhesion tension, radioactivity, counters, electroscopes, refractivity, crystal models, electron diffraction, heats of combustion, the cyclotron, mechanism of electrode potentials and overvoltage.

Organic Chemistry, Biological Chemistry, Pharmaceutical Chemistry. Hormone products, carcinogenic materials, local anesthetics, hypnotics, mydriatics, antispasmodics, absorption spectra, clinical investigation, dental caries, blood diseases, arthritis.

Analytical Chemistry, Inorganic Chemistry. Spectrographic methods of analysis, food and drug analysis, titanium precipitates, urea precipitates, tetraphenylarsonium compounds, mineralogical museum.

Extrachemical. Burton Memorial Tower, Horace Rackham School of Graduate Studies, Lawyers' Club, Michigan Union, the new Health Service.

Chemical and Metallurgical Engineering, General Laboratory. Fluid flow, heat transfer, evaporation and crystallization.

Gas, Fuels and Petroleum Laboratories. Analysis, calorimetry, equilibrium cells, columns and pilot plant for equilibrium studies.

Metallurgical Laboratory. Stress-rupture units, creep, vacuum gas analysis apparatus, high-temperature tensile and impact machines.

Michigan State Highway Testing Laboratories. Physical and mechanical testing of road-building materials.

RECENT DEATHS

Dr. Raymond Smith Dugan, professor of astronomy at Princeton University, died on August 31. He was sixty-two years old.

Dr. Lester P. Breckenridge, professor emeritus of mechanical engineering of the Sheffield Scientific School, Yale University, died on August 22 at the age of eighty-two years.

Dr. Edward Martin Kindle, chief of the Division of Paleontology of the Geological Survey of Canada, died on August 29 at the age of seventy-two years.

Colonel Thomas L. Rhoads, Medical Corps, U. S. A., retired, chief surgeon of the First Army of the American Expeditionary Forces during the world war, died on August 20. He was seventy years old.

Henry Hudson Nicholson, professor of chemistry and director of the chemical laboratory of the University of Nebraska from 1882 to 1905 and later a consulting engineer, died on August 17 at the age of ninety-five years.

Louis Agassiz Shaw, assistant professor of physiology in the School of Public Health of Harvard University, died on August 27 at the age of fifty-four years.

Dr. Harold Douglas Singer, professor of psychiatry at the College of Medicine in Chicago of the University of Illinois, died on August 28 at the age of sixty-five years.

Dr. Ernest H. Lindley, chancellor emeritus of the University of Kansas, professor of psychology from 1898 to 1917, died on August 21 aboard the Japanese liner *Asama Maru*. He was seventy-one years old.

Mrs. Mary Vaux Walcott, wife of the late Dr. Charles D. Walcott, formerly secretary of the Smithsonian Institution, in which she was research associate, died on August 22. She was eighty years old.

The death is announced of Dr. Hugo Merton, formerly of Heidelberg, who had been working in the Crew Institute of the University of Edinburgh.

Sir Joseph (John) Thomson, Cavendish professor of experimental physics at the University of Cambridge from 1884 to 1918, when he became master of Trinity College, died on August 30 in his eighty-fourth year.

SCIENTIFIC NOTES AND NEWS

In recognition of "distinguished service in the hospital field" the American Hospital Association will present its 1940 Award of Merit to Dr. Sigismund S. Goldwater, commissioner of hospitals of New York City, at the annual convention to be held in Boston during the week of September 16.

THE poultry building of the College of Agriculture and Experiment Station of Cornell University was dedicated in June and formally named Rice Hall. *The Experiment Station Record* points out that this is the first college building in the country to be named in honor of a poultryman. It writes: "During his thirty years of work at the university as head of the department, Emeritus Professor James E. Rice molded the thought and activity of many engaged in the industry. He was an eminent teacher and contributed much toward the development of poultry research." The speakers at the dedication included President Edmund E. Day, of Cornell University; Dr. Carl E. Ladd, dean of the New York State Colleges of Agriculture and Home Economics and director of the experiment station; Dr. Liberty Hyde Bailey, formerly dean of the College of Agriculture; representatives of leading poultry interests, and Professor Rice.

O. L. BEISWINGER, of Akron, was elected president of the National Association of Power Engineers at the annual convention at Columbus, Ohio. Stephen C. Castell, of Davenport, Iowa, was elected vice-president.

DR. WILLIAM E. AYLING, of Syracuse, N. Y., was elected president of the New York State Association of School Physicians at the recent annual conference held at Saratoga Springs.

DR. ISAAC H. JONES, of Los Angeles, was elected president of the Pacific Coast Oto-Ophthalmological Society at the recent meeting in Spokane.

JOHN FULTON, after serving for forty-three years in the Oregon State College at Corvallis, since 1907 as head of the department of chemistry, has retired to part-time service as professor emeritus. Dr. E. C. Gilbert, since 1930 professor of chemistry, has been appointed acting chairman of the department.

DR. OSWALD N. ANDERSEN, assistant superintendent of Barnes Hospital, St. Louis, has been appointed general director of the School of Hygiene and Physical Education at Stanford University with the rank of associate professor.

DR. ELWOOD C. DAVIS, who has been in charge of professional preparation and research in physical education at Pennsylvania State College, has been appointed head of the department of physical education at the University of Pittsburgh. He succeeds Dr. John Dambach, who resigned last year to become head of the same department at Queens College, New York.

DR. ROBERT L. MCMURRAY, assistant professor of pharmacy at the Ohio State University, has been appointed associate professor of pharmacy at Washington State College.

DR. JOHN B. LUCKE, associate professor of geology, will become head of the department of geography at the University of Connecticut. He succeeds Dr. Richard E. Dodge, who retired a year ago and is now professor emeritus.

DR. TIMOTHY P. WHITE, who recently retired from the Bureau of Animal Industry, has been appointed professor of anatomy and histology in the School of Veterinary Medicine of Middlesex University, Waltham, Mass.

CHARLES W. COTTERMAN, instructor in genetics and biometry at the Ohio State University, has become a research associate in the laboratory of vertebrate genetics at the University of Michigan. He will conduct studies in human heredity for which funds have been provided by the Board of Governors of the Horace H. Rackham School of Graduate Studies.

BORIS A. KRUKOFF, who has been associated with the New York Botanical Garden while working on his collections of South American plants, has been appointed honorary curator of economic botany.

Current News of Chemistry and Chemical Engineering reports that Harold A. Frediani, until recently instructor in charge of analytical industrial chemistry at the Louisiana State University, has been appointed assistant director of the Fisher Scientific Company Development Laboratory, Pittsburgh, Pa.

The Journal of Chemical Education, edited for the division of education of the American Chemical Society by Professor Norris W. Rakestraw, of Brown University, has formed a group of associate editors. They are: Hubert N. Alyea, Princeton University; Tenney L. Davis, Massachusetts Institute of Technology; Ed. F. Degering, Purdue University; William A. Felsing, the University of Texas; Malcolm M. Haring, the University of Maryland; Philip A. Leighton, Stanford University; Laurence L. Quill, the Ohio State University, and Elbert C. Weaver, Bulkeley High School, Hartford, Conn.

DR. H. A. GLEASON returned to the New York Botanical Garden on August 10 after a two-months' collecting trip in the eastern and middle western states, bringing back 3,000 specimens for the herbarium. Accompanied by John Dwyer, a graduate student from Fordham University, he covered territory from New York to Virginia, west to the Mississippi and Missouri Rivers and north to Minnesota and the Great Lakes region.

DR. A. J. RIKER, professor of plant pathology at the University of Wisconsin, and Dr. P. W. Zimmerman, of the Boyce Thompson Institute, members of a committee for the study of cancer problems and overgrowths in plants, visited the New York Botanical

Garden on August 13 to consult with Dr. B. O. Dodge and members of the laboratory staff of the garden on further activities of the committee.

Professor Roy S. Swinton, on leave of absence from the University of Michigan, will join the faculty of the University of the Philippines in Manila, P. I., for a year. Professor Swinton, who was at the University of the Philippines from 1911 to 1913, will advise the university on the installation of a new mechanics and hydraulics laboratory.

The tenth International Congress of Dermatology and Syphilology will be held in New York City in September under the presidency of Dr. Oliver S. Ormsby. Dr. Paul A. O'Leary, of the Mayo Clinic, Rochester, Minn., is executive secretary.

The twenty-third annual meeting of the American Society of Ichthyologists and Herpetologists was held in Toronto from September 2 to 4. Sessions were held at the Royal Ontario Museum of Zoology. There was an "open house" in the Biological Building of the University of Toronto on Monday evening. The annual dinner was held in Hart House. On the last day of the meeting there were joint sessions with the American Fisheries Society.

The National Advisory Cancer Council at a meeting on June 25 at the National Cancer Institute in Bethesda, Md., awarded grants for research on cancer: Washington University School of Medicine, St. Louis, $16,000; Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York, $3,300; Barnard Free Skin and Cancer Hospital, St. Louis, $5,000; University of California Medical School, San Francisco, $5,000, and American College of Surgeons, Chicago, $5,900. Among reports presented at the meeting was a special one on protection of personnel working in cancer clinics against injury from exposure to radium, x-rays and neutrons, by Carl Voegtlin, chief of the cancer institute.

The Newark Museum has received from Louis Bamberger, of South Orange, a gift of new exhibits and study equipment for the science department. The new material, most of which will be specially designed and made to order, will be ready for installation later this autumn, according to Miss Beatrice Winser, director of the museum. Mr. Bamberger is vice-president of the Board of Trustees. Among the exhibits and equipment acquired through the Bamberger gift are an electrically operated model of the solar system on which the planets move in related speed to one another, a fluorescent mineral room where ultra-violet lamps bring out hidden qualities and colors in minerals; a model of a drop of pond water magnified two hundred and fifty times to show microscopic plant and animal forms, two microscopes and a microprojector together with a number of slides; a series of working models illustrating the structure of the human body, and an "illusion exhibit machine" which performs such miracles as apparently reducing a duck to its skeleton or changing a weasel from summer brown to winter white. The new material will be installed as received and a formal opening of the science department with an entirely new set-up will be held later in the autumn.

Commander F. W. Reichelderfer, of the U. S. Weather Bureau, has made a statement to the effect that only three institutions in the country now have an advanced meteorological course, and these have each graduated from ten to twenty men a year. Most of the men have been Army and Navy officers sent there by the military service. There have been only about ten to twenty men each year for civilian occupations. This is due to the fact that the opportunity for employment has been limited. However, he states that the new five-day weather forecasting system, initiated recently by the Weather Bureau, is creating a demand for meteorologists.

An Associated Press dispatch states that construction of a $1,250,000 addition to the plant of the Spencer Lens Company, Buffalo, N. Y., to provide facilities for national defense production, started on September 3. Burton H. Witherspoon, president of the company, states that production facilities have been increased about 50 per cent. and employment has been raised from 1,000 workers to 1,600.

Nature states that Dr. Charles Slater, consulting bacteriologist to St. George's Hospital, London, who died on March 15, bequeathed £10,000 to St. George's Hospital for teaching bacteriology or research work in that science, £5,000 to the University of Manchester for the equipment and maintenance of the laboratories and £4,000 to the University of Cambridge for teaching or research work in medical science.

DISCUSSION

THE FIRST THOUSAND MATHEMATICAL WORKS PRINTED IN AMERICA

The University of Michigan recently published a volume (xxvi + 697 pp.) entitled "Bibliography of Mathematical Works Printed in America through 1850," edited by Louis C. Karpinski, with the cooperation for Washington libraries of Walter F. Shenton. This book is especially useful to librarians, but it is also of interest to students of the early development of mathematics in the Americas. In fact, on page xi it is stated that "these illustrations constitute a pictorial history of American mathematics through 1850 on a scale that has not before been attempted with any similar group of American imprints." While mathematical history and mathematical bibliography have much in common their fundamental objectives usually differ widely, and the present work is a bibliography as its title clearly indicates.

A difference between the objectives of a mathematical history and a mathematical bibliography was stated emphatically by the well-known former writer on the history of mathematics, Moritz Cantor (1829–1920), at the International Congress of Mathematicians held at Paris, France, in 1900 and reported in the *Bulletin of the American Mathematics Society*, volume 7, by Charlotte A. Scott (1858–1931), then at Bryn Mawr College. In passing over many minor writers on the subject he remarked "tous aussi morts que leurs livres; gardons—nous de les ressusciter." Probably most historians of mathematics would not be in full accord with this dictum, notwithstanding the great reputation of its author. On account of the vastness of the material with which the modern mathematical historian has to deal it frequently becomes necessary to confine the attention at first to what appears to be most important, and in doing this the first thousand mathematical works printed in America would usually not receive much attention.

While the work under consideration lists only about one thousand different publications without counting different editions of the same work, when these are counted the number of the listed publications is nearly three thousand. As might be expected most of them are text-books which were usually based on more extensive and in most cases better foreign publications. It is interesting to note that the early Spanish publications usually deviated more from their source material than those which appeared in the English language. The earliest work noted is the "Sumario" by Juan Diez Freyle, which was printed in Mexico in 1556 but is much inferior to the well-known "Ars Magna" published by the Italian mathematician, H. Cardan, about eleven years earlier. Various other earlier European mathematical publications are also superior to this earliest known mathematical work printed in America.

In an appendix the author deviates from the title of the work under consideration by treating briefly native American mathematical developments (pp. 607–611). These native developments are much inferior to those made by the Babylonians more than three thousand years before Columbus discovered America. In particular, the Babylonians solved at that early date certain quadratic equations in the sense that they found at least one root of such an equation by methods which are still being used by our high-school students. Much has been written about the ancient Mayan and the ancient Peruvian mathematics, but most of this relates to their methods of representing numbers and exhibits very little mathematical insight in comparison with much older developments in Babylon and in Egypt.

While this volume revives many authors who were as dead as their books it will doubtless be welcomed by the librarians and also by many others who are interested in the early development of mathematics in our country even if the destruction of all these books would not diminish materially our mathematical knowledge. Many will find pleasure in verifying for themselves the lack of originality in the material of nearly all these works and will thus be more impressed by the very slow growth of our modern mathematical knowledge. The abstract form of this knowledge has become so widely useful in our age as a result of the great scientific advances which have demanded continually greater brevity in our statements as regards exact situations.

G. A. Miller

University of Illinois

PRACTICAL SUGGESTIONS FOR REDUCING THE LABOR OF INDEXING A TEXT-BOOK

Indexing is an individualistic task which varies with the type of book concerned. While there are no fixed rules, the general principles outlined in this article may be found of assistance to medical and other authors who wish to index their own texts.

Indexing technique must be flexible and allow expansion and rearrangement of entries in order to allow re-use of original drafts of entries when preparing the index of a revised edition. Since each entry must be separable, either individual slips of paper or file cards are customarily used for each entry. The use of letter size sheets of paper each ruled horizontally into four sections—one section for each entry—reduces the number of insertions required in typing.

The selection of subjects and of index entry words requires judgment based on knowledge of the subject, and is improved by some knowledge of indexing. Words which are to be used as leading words of index entries should first be checked *by the author* on the printer's page proof of the text. When the desired leading word does not occur in the text, it should be written in the margin of the page proof at the proper place.

In deciding upon subjects to be indexed and wording of entries, the author must take into consideration whether the book and index are for the general reader or for the expert. He must also decide whether to make descriptive entries or whether to compile simply a skeleton type index. The subject of the text itself should not be used as an index entry heading. Capitals should be used sparingly. The page number should be preceded by a comma and should follow the last word of each entry without intervening spaces.

After entry words have been checked by the author on the page proof of the text, an assistant may complete the task of indexing.

Subheadings in a group of entries having the same entry word must be arranged alphabetically. It is difficult to alphabetize subheadings which inadequately describe the entry word. When impossible to alphabetize such subheadings, they may be arranged in progressive order of page numbers.

The complete entries drafted from the entry words checked on the printer's page proof of the text are typed in consecutive order on the quarter-ruled letter size sheets. Each sheet of four entry slips should be numbered consecutively in the upper right-hand corner. A carbon copy of each sheet is preserved intact in original consecutive order. These carbon copies obviate the necessity for rearrangement of the original entry slips from alphabetic back into consecutive order in making a revised edition of the text and index.

On a photographer's cutting board several quarter-ruled sheets at a time are cut into their four separate slips each bearing a single entry.

The cut slips are then sorted into alphabetic order, first according to the leading letter and later according to the second and third letters of the first word of each entry. Alphabetic arrangement is based only on the leading word of each entry. The word which follows the leading word does not form an entity with the latter for purposes of alphabetizing. A compound word is, however, treated as an entity.

The individual slips are then edited and revised. Whenever several entry slips bear identical entries, the page numbers of these are entered in consecutive order upon a single entry slip and the superfluous original slips discarded. Groups of entries having the same entry word are then arranged alphabetically in indented setting, eliminating repetition of their entry word. Cross references are made on blank entry slips and inserted wherever necessary. Errors in alphabetizing are then corrected.

Individual entry slips, arranged in the order in which they are to appear in the index, may be numbered consecutively in the upper left-hand corner of each and sent in slip form to the printer. It is not necessary that they first be pasted upon sheets of paper in their consecutive order, or that they be typed again into a regular manuscript of the index.

Each entry in the printer's galley proof of the index must be checked against the page proof of the text. There is no short cut or substitute for this final recheck.

Index page proof should first be read through for verification of alphabetical order of entries. On the original entry slips ditto marks were used for groups of entries having the same entry word. A second reading is necessary to make sure that none of these ditto marks have been retained as column headings in the page proof of the index. When division of such groups is carried over from one column to the next, the entry word (without page number) should be repeated at the head of the new column.

Insertions in the text of revised editions will render incorrect the page numbers of many of the subsequent index entries. The carbon copies of each sheet of four entries preserved intact in original consecutive order of page numbers are compared with the page proof of the revised text. Where necessary, new page numbers are then assigned to the previously drafted entries. From this point on, the indexing of the revised edition is similar to that of the original.

The method described in this article makes re-drafting the bulk of the index entries in a revision of the index unnecessary. It also avoids the necessity of taking all the previously alphabetized entry slips out of alphabetic order and rearranging into their original consecutive order to permit these drafted entries to be used again in the index of the revised edition of the text.

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THE INCIDENCE OF HYDROGEN SULFIDE AT KILAUEA SOLFATARA PRECEDING THE 1940 MAUNA LOA VOLCANIC ACTIVITY

Periodic analyses of the solfataric gases at Kilauea have been carried out by the writers over a period of two years, with the purpose of determining whether there is a correlation between the constitution of these gases and volcanic activity in Kilauea. Since the lavas of this volcano and of near-by Mauna Loa volcano are known to have the same origin, it was felt that there might also be found a relationship to periods of Mauna Loa activity.

Aside from steam, which is the predominant gas, Kilauea solfataric gases were found to be composed of 85 to 98 per cent. carbon dioxide, 1 to 15 per cent. sulfur dioxide and approximately 1 per cent. air. There have been irregular variations in the sulfur dioxide-carbon dioxide ratio during the two-year period, and no eruption of either volcano has occurred.

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[1] Acting assistant surgeon (dermatology), Office of Dermatoses Investigations, U. S. Public Health Service, Bethesda, Maryland. Medical Director Louis Schwartz in charge.

No other gases were present in detectable quantities until just prior to the present Mauna Loa activity.

In the collection of March 14, 1940, however, hydrogen sulfide appeared for the first time. It was easily detected qualitatively by odor, by the darkening of lead acetate paper and by the formation of yellow cadmium sulfide when the gas was passed into cadmium sulfate solution. There was not sufficient hydrogen sulfide to make its quantitative determination possible.

On April 7, 1940, volcanic activity broke out at the summit of Mauna Loa. Samples of solfataric gas collected at Kilauea on April 11 again showed the presence of hydrogen sulfide, and samples collected on April 21 likewise contained hydrogen sulfide. The collections of May 10 and June 18 showed no hydrogen sulfide, even though Mauna Loa was still erupting, although with greatly lessened activity.

The appearance of hydrogen sulfide in the Kilauea solfataric gases just prior to Mauna Loa activity may have been a premonitory sign. If so, this appears to afford an exceedingly valuable method of forecasting volcanic outbreaks. Furthermore, this incidence of hydrogen sulfide suggests a close relationship between solfataric activity and primary volcanism.

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SCIENTIFIC BOOKS

A GEOLOGICAL EXPEDITION TO THE SUNDA ISLANDS

Geological Expedition of the University of Amsterdam to the Lesser Sunda Islands in the Southeastern Part of the Netherlands East Indies, under the Leadership of H. A. Brouwer. Vol. 1, 348 pages, with numerous plates, maps and sections, 1940. Amsterdam (American sales agent, Nordeman Publishing Company, New York). Price, $8.40. Work to be completed in four volumes, by 1941; price for the set, $33.50.

THE able geologists and geophysicists of Holland have already shown that the vast East Indian Archipelago is supremely important for the genetic problems of continental stability, the origin of sea basins and the origin of mountain chains. Because it is a key region for investigations of terrestrial dynamics, the new data recorded in this four-volume symposium, due to the energy of Professor Brouwer, are particularly welcome. The present volume, on the geology and paleontology of the Netherlands half of the island of Timor, is written by D. Tappenbeck, A. L. Simons (both dealing with the general geology); by F. A. H. W. de Marez Oyens, another member of the 1937 expedition; and by Professor J. Wanner, of Bonn University. Oyens describes the Permian crinoids of Timor, and Wanner the Permian blastoids. Throughout, the emphasis is on the details of observation, in field and laboratory. The projected fourth volume "will coordinate the different contributions [including also those by seven other members of the expedition] and give the general conclusions which might arise."

The oldest system of Timor rocks, crystalline schists, were carefully studied; their age is pre-Triassic, but could not be more closely determined. Sedimentary series belonging to the Permian, Triassic, Jurassic, Cretaceous and Tertiary were found; unfortunately, their respective thicknesses are not given. An outstanding conclusion of Tappenbeck is that the Tertiary epoch of intense folding and thrusting should be placed in Oligocene time, rather than in the mid-Miocene, as so long believed by other investigators. Since Timor lies in the great "negative strip" of gravity anomalies, discovered by Vening Meinesz, this change of date for the major, orogenic disturbance of Tertiary time has significance for the general theory of mountain-making. The Simons chapter describes large masses of serpentine, especially voluminous along the north shore of the island; here is another proof that eruption of ultra-basic, igneous rock is an accompaniment of the intense deformation along the principal mountain arcs.

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THE INVERTEBRATES

The Invertebrates: Protozoa through Ctenophora. By LIBBIE H. HYMAN. First edition. 726 pp. McGraw-Hill Publications in the Zoological Sciences. A. Franklin Shull, consulting editor. 1940.

DR. HYMAN is to be congratulated on the appearance of the first volume of her courageous project to furnish a reasonably complete and modern account of the morphology, physiology, embryology and biology of the invertebrates. The real need of an accurate and critical survey of this sort in English has long been recognized alike by teachers, professional zoologists specializing in other fields and by advanced students. The author has achieved a satisfying measure of success in this important, confused and difficult field. "It is obviously impossible," Dr. Hyman says in her preface, "for any one person to have a comprehensive first-hand knowledge of the entire range of invertebrates, and consequently a work of this kind is essentially a compilation from the literature." It is obvious to the reader that the present work is not a mere rehashing of the literature but a fresh study of a wealth of fascinating material. Dr. Hyman has had the interest and energy to engage herself in the Herculean task of dealing at first hand with many of the animals she is discussing. The majority of the profuse illustrations were made by the author directly from living and prepared specimens. For this purpose several summers were spent at various marine stations.

The original conception of the work was a three-volume treatise: one volume devoted to the non-coelomate invertebrates, a second volume for the coelomate forms, except arthropods, and a third volume for the arthropods. However, after six years of intensive work, it developed that the first volume would have to be split into two parts: (1) the lowest invertebrates through the radiate forms and (2) the acoelomate and pseudocoelomate bilateral animals. The present volume of 726 pages is part one. The book opens with two short introductory chapters, the first on protoplasm, the cell and the organism, and the second on classification. During the discussions of the fundamental nature of the developmental process and the nature of life there are challenging and provocative analyses of the chromosome-gene theory and the mechanistic theory. The chapter on classification summarizes previous taxonomic practices and briefly gives the author's reasons for her present scheme: 22 phyla based primarily on anatomical and embryological facts and on a number of important characters (not any one arbitrarily chosen feature) including general grade of construction, type of symmetry, presence and kinds of body space, absence or presence of an anus, presence of segmentation, possession of appendages, presence and nature of excretory, respiratory and endoskeletal systems. Dr. Hyman's procedure seems sound, conservative and workable. It should form a useful basis of discussion and further investigation. The Mesozoa and the Parazoa are separated from the Eumatozoa, which are divided into radiate and bilateral (in preference to diploblastic and triploblastic) grades. Among the Bilateria, three types of structure are recognized (following Schimkevitch), namely, the acoelomate, pseudocoelomate and eucoelomate types. "Such a division stands firmly on a realistic anatomical basis and eschews all theoretical vaporizings such as the alleged degradation of flatworms from annelids, the coelomic nature of the gonad cavities, and similar ideas." The Eucoelomata are subdivided into the Schizocoela and Enterocoela (Huxley). A suggestive phylogenetic tree (which readers are cautioned not to take too literally) derives the Bilateria from a primitive flatworm by way of a stereogastrula type of ancestor. Above the ancestral flatworms, the phyla are arranged in two main lines of ascent, the groups with determinate cleavage and mesoderm originating from definite cells or bands (Protostomia) and the groups with indeterminate cleavage and mesoderm and coelom arising as endodermal sacs (Deuterostomia).

The bulk of the book is devoted to detailed consideration of the Protozoa, the Mesozoa, the Porifera, the Cnidaria and the Ctenophora. The treatment of each group is introduced by a brief historical résumé. Then follow explanations of characters of the Phylum, classification, general morphology and physiology, discussion of the major divisions, phylogenetic and general considerations—including embryology, behavior, regeneration and ecological relations. Paleontology is given brief consideration. Each chapter is followed by an extensive and well-chosen bibliography, brought up to date. The author's approach, throughout, has been basically morphological. Not only gross structure but histological and cytological features are elucidated. The method of presentation is such that the text is to a large extent a discussion and elaboration of the illustrations. Specificity, clarity and economy are effectively achieved by this type of organization. The volume contains 221 figures, most of which occupy a full page and include a half dozen or more drawings, largely original. The rest are selected from the literature; many are redrawn. All are skilfully executed and well labeled. The "type" method has been avoided, since one of the major purposes of this treatise is to give an extensive account of the range of morphological variation to be found within each group. Frequently, original observations fill gaps in the literature and correct wide-spread misconceptions even about some of our common laboratory animals.

For the average zoologist, perhaps the greatest value of this book will be the opportunity of convenient access to the perplexing vocabulary of invertebrate morphology. Terms are explained clearly, often in relation to their homologues. In addition, the author has made an earnest effort to bring order out of confused terminology. As one example, such words as ectoderm, entoderm and stomodaeum have been limited to embryological stages. In their stead, the terms epidermis, gastrodermis and pharynx have been used for adult animals. One might be tempted to quibble with minor points such as the preferred definition of the cell or the concept of the acellularity of the Protozoa. Taxonomy can not fail to be controversial.

The technical execution of the book is admirable. There are surprisingly few typographical errors. The book is well indexed. It is earnestly hoped that the author will be able to complete the other volumes of the treatise, as visualized. Biology and the standard of biological teaching are certain to benefit by this capable revaluation of the invertebrates, in the light of recent progress, by an investigator of mature experience.

WILLIAM F. DILLER

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REPORTS

SUMMARIZED PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE FROM 1934 TO 1940

THE Summarized Proceedings volume of the meetings of the American Association for the Advancement of Science and of the Pacific and Southwestern divisions for the years 1934–1939, inclusive, is now in the press and is expected to be ready for distribution in October.

From the founding of the association in 1848 until 1910, with the exception of 1861–65, Proceedings were published each year. Since 1910 Summarized Proceedings for several years each have been published in one volume as listed in Table 1:

TABLE 1

PERIOD	MEETINGS	PAGES
1911–1914	4	495
1915–1920	7	712
1921–1924	6[1]	979
1925–1928	6[1]	1,191
1929–1933	8[1]	1,245
1934–1939	21[2]	1,200

[1] Brief part-page reports of the meetings of the Pacific and Southwestern divisions were included.

[2] Includes twelve meetings of the association, one a joint meeting with the Pacific Division and one a joint meeting with both the Pacific Division and the Southwestern Division; four meetings of the Pacific Division and five meetings of the Southwestern Division, the summarized reports of which are almost as complete as are those of the meetings of the association.

Perhaps the best way to give a general idea of the contents of the forthcoming Summarized Proceedings is to quote its Preface, which is as follows:

PREFACE

The mere sight of a large book raises the question whether it is worth what it cost in labor and money. Is it just another ponderous addition to burdened library shelves? Will it serve any useful purpose? These questions will be asked about this volume; the answer to them should be based upon its contents.

In one respect this volume is unique. It contains the names of the more than 21,000 members of the Association arranged by states and towns, with the field of special interest of each one indicated. Since a very large percentage of the leading scientists of the United States and Canada are members of the Association, there is in this book a convenient answer to the often-arising question concerning what scientists in some special field live in a certain part of the country.

This volume contains also an alphabetical directory, which includes the names of all members of the Association, the degrees they have received, the academic or other positions they hold, their institutional or street addresses, their complete records as members of the Association, and the offices they have held in the Association.

This volume, however, does not consist primarily of lists of names. It contains a brief history of the Association since it was founded in 1848, and, consequently, of the development of American science, at least as far as it has been represented in the meetings of the Association. For clarity this history is divided into sections, each beyond the first being devoted to a decade. Each section includes a brief characterization of the science of the period, a list of the presidential addresses delivered in it, often with quotations of interesting passages, the titles of other papers of special interest, and, if they are published, the places of their publication. The constitution adopted in 1874 established vice-presidents for the sections who delivered retiring addresses, the titles and places of publication of which down to 1920 are included.

The section devoted to the period from 1921 to 1940 includes the titles and places of publication of the addresses of the presidents of the Pacific and Southwestern divisions from their organization. It includes also the titles and places of publication of all the Annual Sigma Xi addresses, of all Phi Beta Kappa addresses, of all Hector Maiben Memorial lectures and of all John Wesley Powell lectures, and, except in the few cases in which they are not known, the places of their publication.

Since this volume is especially a permanent summary record of the proceedings of the Association for the period from 1934 to 1940, the reports of its meetings for these years contain much more information than do those for earlier years. The titles listed include not only those of the addresses of presidents and vice-presidents but also all those that were open to the public as general sessions, with references to the places of their publication. The titles of more than two hundred and fifty addresses and papers are given. This volume also contains the titles of all the symposia presented at the twenty-one meetings of the Association and its divisions from 1934 to 1940, a total of more than two hundred at which nearly fourteen hundred papers were read.

In short, this volume contains sketches of the science of our predecessors and much of that which is recent. Those whose memories reach back a few decades will feel as they read of the youth of the Association a certain nostalgia for simpler days and attitudes that have passed. It is hoped that they will catch enough echoes from the historical part of this record to awaken in them many happy memories and only pleasant anticipations for the future. Those who are in the early parts of their scientific careers will be most interested in current progress in science. They may even be a little amused at what now seem naive ideas that were held in earlier days. Yet, it is hoped that for them the historical sections of this book will sometimes serve as a little mirror, like that in the front of a motor car, in which they may catch enough glimpses of the road science has traversed to assist them in steering it wisely into the future.

There are many items of interest in the new Summarized Proceedings that are not mentioned in the Preface. For example, the registration and the numbers of papers presented at each meeting of the association since its founding are given, as well as the corresponding data for the Pacific and Southwestern divisions, except in a few cases in which the information is not available. For the first time the Summarized Proceedings contain in the report of each meeting, whether of the association or of one of the divisions, a complete list of the participating societies. Not only are they named, but also the number of papers on the program of each of them is given and all the symposia they organized or in which they participated. The number of papers in each symposium is given and the place of its publication, if published.

The advance sale of the new Proceedings has been so large, now about 4,200 copies, that it is not planned to print a number greatly in excess of those that have been sold. Since the printing will be from type that will be held for only a short time, instead of from plates, copies can be supplied only up to the number originally printed. The prepublication price to members of the association is $2.75 per copy, clothbound; after publication it will be $3.00. To those who are not members of the association it will be $4.00 per copy. The pages are 6 by 9 inches.

Table 2 gives comparative data for the preceding four volumes of the Summarized Proceedings and for the one now in press.

TABLE 2

PERIOD	COPIES PRINTED	UNIT PRICE	TOTAL RECEIPTS	TOTAL COST
1915–20	2,262	$1.00	$ 2,794	$ 5,430
1921–24	4,500	2.00	6,390	9,297
1925–28	4,250	3.50	11,060	11,060
1929–33	4,000	2.50	8,001	11,404
1934–39	4,500(?)	2.75	11,550	9,800(?)

The estimated cost for the volume in press includes printing, binding, cartons, mailing, postage, clerical help and circularization. The total deficit of the four Summarized Proceedings published from 1915 to 1933 inclusive was $8,886, or an average per issue of over $2,200. As a consequence of these deficits the office of the Permanent Secretary has been setting up reserves of about $1,000 per year to cover the prospective deficit on the present volume. Apparently the reserve may be held intact for the next volume.

F. R. MOULTON,
Permanent Secretary

SPECIAL ARTICLES

MORPHOLOGICAL AND FUNCTIONAL RECOVERY OF THE PANCREATIC ISLANDS IN DIABETIC CATS TREATED WITH INSULIN

PERMANENT diabetes has been produced in the normal dog by the injection for a few weeks of a crude saline extract of anterior pituitary glands.[1,2] Young[1] was not able to make normal cats permanently diabetic; nor were we in similar experiments. However, if one half to three fourths of the pancreas is removed, leaving enough to prevent spontaneous hyperglycemia and glycosuria, it is possible to make such cats permanently diabetic by a course of injections of anterior pituitary extract. Fifteen such animals have been prepared. The diabetes has persisted throughout the period of observation, which in some instances has been as long as five months after the last injection of anterior pituitary extract. Some of the permanently diabetic cats have been treated with insulin in an attempt to control the hyperglycemia. In five of these animals insulin was stopped after varying periods of freedom from glycosuria and hyperglycemia. In these five animals (see Table I) the withdrawal of insulin was not followed by a return of glycosuria, and the blood glucose was within normal

TABLE I

DIABETIC CATS RECOVERING AFTER INSULIN TREATMENT

Cat No.	Glycosuria		Severity of diabetes*	Duration of insulin therapy	Duration of recovery†
	During injection of ant. pit. extract	Interval between ant. pit. extract and insulin			
	days	days	per cent.	days	days
R– 3	43	29	60	24	105
R– 5	18	15	64	27	56
R–10	25	56	43	20	100
R–12	10	12	63	32	113
R–21	13	6	66	9	36

* Expressed as the percentage of the calculated available glucose of the diet (21.6 gm/day) excreted in the urine for 6 days prior to insulin therapy. For R–21 the previous 2 days were used.

† Non-diabetic period from cessation of insulin therapy to end of experiment.

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[1] F. G. Young, *Biochem. Jour.*, 32: 513, 1938.

[2] F. C. Dohan and F. D. W. Lukens, *Am. Jour. Physiol.*, 125: 188, 1939.

limits before and after feeding. The diet, with one minor exception, was constant. The daily rations consisted of 200 grams of beef heart supplemented with cod-liver oil, yeast and bone ash. This recovery from the previous diabetic state has been maintained to the termination of the experiment, a period of more than three months in several of the animals. The cats continued to gain weight throughout this period.

Biopsy specimens of the pancreas of permanently diabetic cats taken *before* treatment with insulin show marked hydropic degeneration of the islands of Langerhans. In cats exhibiting functional recovery *following* insulin therapy the islands are histologically normal. Some animals did not show "permanent" recovery with insulin treatment. These instances were associated with infections, poor control of the diabetes by insulin or institution of insulin treatment after more than five months of diabetes.

In dogs made diabetic by removal of about nine tenths of the pancreas hydropic degeneration of the islands is present for the first few months.[3] Using such dogs, Copp and Barclay[4] have observed morphological restoration of the islands *during* periods of insulin therapy. Despite the morphological improvement it was necessary to continue the administration of insulin. Since the diabetes had been produced by partial pancreatectomy alone, it was not to be expected that morphological restoration of the remaining islands would maintain functional recovery. We have failed to obtain morphological (or functional) recovery in dogs made permanently diabetic with anterior pituitary extract. This we attribute to the early development of atrophy of the islands of Langerhans in our dogs, in contrast to the hydropic degeneration found in the experiments of Copp and Barclay and in our cats. However, it has recently been demonstrated in dogs that the concurrent administration of insulin may hinder the fall in the insulin content of the pancreas and the hydropic degeneration of the islands which occurs during the period of injection of certain anterior pituitary extracts.[5]

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[3] F. M. Allen, *Jour. Metab. Res.*, 1: 5, 1922.

[4] E. F. F. Copp and A. J. Barclay, *Jour. Metab. Res.*, 4: 445, 1923.

[5] J. Campbell, R. E. Haist, A. W. Ham and C. H. Best, *Am. Jour. Physiol.*, 129: P328, 1940.

THE NEURO-MOTOR MECHANISM OF THE SMALL BLOOD VESSELS OF THE FROG

THE mechanism which regulates capillary blood flow has not been definitely established. In Krogh's laboratory, Vimtrup[1] reported the contraction of Rouget cells in Amphibia, which caused folding of the endothelium. Field,[2] using the frog and rat, and also Beecher,[3] using the rabbit's ear, confirmed Vimtrup and in addition observed the swelling of endothelial nuclei which blocked the lumen of the capillary. The Clarks[4] reported endothelium to be contractile in the tadpole's tail but not in the rabbit's ear. They deny the contractility of extra-endothelial cells (Rouget cells) in mammals and amphibians, with the possible exception of the nictitating and hyaloid membranes of the frog. Zweifach[5, 6] reported endothelial contractility in the frog and mouse. In response to mechanical stimulation, contraction of the endothelium in the frog "completely closed the lumen of the vessel only at its ends." At the "capillary exit in those regions where the capillary offshoot leaves the arteriole," he observed valve-like folds of endothelium which opened and closed passively with dilatation and constriction of the arteriole. In the mammal Zweifach[7] comes to the conclusion that the contractility of capillary endothelium has little physiological significance.

We have examined, by means of stimulation with a micro-electrode, the distribution of the contractile elements of the small blood vessels in the retrolingual membrane of the frog. In contrast to the uniform layer of the typical smooth muscle of the arteriole, and the somewhat scattered arrangement on the precapillary, the modified smooth muscle cells of the capillary are confined to the region of its origin. If the capillary branches before emptying into a venule, the branches are devoid of smooth muscle cells and do not contract. The region of the capillary origin may act as a unit with its adjacent blood vessels, but frequently it acts independently of them as a sphincter-like mechanism. This concept of the control of capillary blood flow is supported by the evidence presented below.

In the frog with brain and medulla pithed, the retrolingual membrane was prepared for illumination by transmitted light, after the method of Pratt and Reid.[8] A micro-electrode, 1–5 micra, was placed in the field by an Emerson micromanipulator. Cinephotomicrographs were obtained, using a light-splitting prism.

Brief faradic stimulation of the small vasomotor nerves produced dilatation of the small blood vessels, followed by constriction. Weak stimulation usually produced only dilatation. Strong stimulation of the same nerve frequently produced only constriction. These results suggest that the nerves stimulated contained vasodilator and vasoconstrictor fibers, and that the vasodilators possessed a lower threshold. Furthermore, the area constricted was frequently only a portion of that originally dilated. As additional evidence of dual innervation, vasomotor nerves were found which produced only one type of response to all strengths of stimulation. Although our histological preparations show an anatomically continuous loosely-meshed non-myelinated nerve plexus continuous with the perivascular plexus, it is conceivable that dilator and constrictor fibers might occasionally become segregated.

---

[1] Bj. Vimtrup, *Zeitsch. f. d. ges. Anat.*, 65: 150–182, 1922.

[2] M. E. Field, *Skand. Arch. f. Physiol.*, 72: 175–191, 1935.

[3] H. K. Beecher, *Skand. Arch. f. Physiol.*, 73: 1–6, 1936.

[4] E. R. Clark and E. L. Clark, *Am. Jour. Anat.*, 66: 1–49, 1940.

[5] B. W. Zweifach, *Anat. Rec.*, 59: 83–108, 1934.

[6] B. W. Zweifach, *Anat. Rec.*, 73: 475–495, 1939.

[7] B. W. Zweifach, *Am. Jour. Physiol.*, 120: 23–35, 1937.

[8] F. H. Pratt and M. A. Reid, SCIENCE, 72: 431–433, 1930.

Faradic stimulation of small nerves produced responses confined to limited vascular areas. Therefore, although the nerve plexus appears to be anatomically continuous, functional innervation is discontinuous. Stimulation of any one of several small nerves in the field produced a response in the same limited area. This fact suggests the concept of a smooth muscle motor-unit. Limited vascular areas were seen to beat rhythmically at times. No central reflex could be involved, and we have found no ganglion cells in the membrane.

Faradic stimulation of small nerves produced dilatation and contraction of the capillary only in the region of its origin. This region may respond independently of the supplying arteriole or precapillary, and function as a sphincter. Such sphincter-like regions sometimes show spontaneous rhythmic contractions, quite independent of the supplying vessel. Nuclei of contractile pericapillary cells were always seen in this region. In preparations vitally stained with methylene blue the capillary origins possessed a few modified smooth muscle cells with branched cytoplasmic processes. They are probably the type of cell originally described by Rouget,[9] redescribed by Vimtrup[10] in Amphibia, and reported by Field[11] in the rat. Furthermore, the perivascular nerve plexus was rich on the arterioles and precapillaries but sparse on the capillaries. Various pericapillary cells were found farther along the capillary. Except for an occasional cell, these did not respond to electrical stimulation. Further experiments are in progress, with drugs and with denervated preparations, to determine the nature of the independent activity and the rhythmic responses.

Both direct observation with a water immersion lens and careful study of the cinephotomicrographs of the active capillary origins failed to disclose the swelling of endothelial nuclei into the lumen, or the presence of endothelial valves. Endothelial contraction in response to stimulation of the nerves or to direct electrical and mechanical stimulation did not occur. It appears, therefore, that in the retrolingual membrane of the frog, the capillary origins are provided with modified smooth muscle cells and thus regulate capillary blood flow in a sphincter-like manner without the aid of the supplying vessel.

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EGG-WHITE INJURY IN CHICKS AND ITS RELATIONSHIP TO A DEFICIENCY OF VITAMIN H (BIOTIN)

THE action of Vitamin H in protecting against the injury caused by a diet containing egg white is somewhat unique in that the diet can not be considered to be deficient in an essential food constituent. Omission of the egg white from the injury-producing diet gives a ration which apparently does not lack any of the needed vitamins. This appears to be in contrast to the action of the various members of the vitamin B group in curing or preventing nutritional injuries, for the diets in these cases have always been found to be definitely deficient in the vitamin in question.

The recent observations of György, Melville, Burk and du Vigneaud have shown that vitamin H is probably identical with biotin (and co-enzyme R).[1, 2] In view of their results, it appeared that a study of the biotin intake and excretion and the biotin content in the tissues of chicks receiving egg-white injury diets might be helpful in throwing some light on the manner in which vitamin H functions.

Day-old chicks were placed on the following diet: yellow corn, 55 per cent.; wheat middlings, 20 per cent.; purified casein, 20 per cent.; bone meal, 1.5 per cent.; limestone, 2 per cent.; cod liver oil, 1 per cent.; and iodized salt, 0.5 per cent. When ten days old, the chicks were divided into two groups. One, the controls, was continued on this same diet, and the other group was given a ration in which the purified casein was replaced by dried egg white. Samples of the two diets, digested in 20 per cent. sulfuric acid for 18 hours at 100° C., gave the following assay values for biotin by the method of Snell, Eakin and Williams[3]: control diet, 0.39γ per gram; injury diet, 0.67γ per gram. Twenty-four-hour samples of the feces from the two groups were collected at intervals throughout a month, dried, weighed and carefully sampled. Aliquots were tested, both for free (extractable) biotin, and for "bound" biotin, *i.e.*, biotin which was liberated after 18 hours digestion of the feces at 100° C. in 20 per cent. sulfuric acid. Although there were some irregularities in the assays, it was found that both groups of chicks were excreting from 10 to 20 per cent. of their biotin intake as free biotin and approximately 15 to 25 per cent. additional as "bound" biotin. On an actual weight basis, the injured chicks were, of course, excreting more than the controls, since their intake was greater.

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[9] C. Rouget, *Arch. de Physiol. Norm. et Path.*, 5: 603–663, 1873.

[10] *Loc. cit.*

[11] *Loc. cit.*

[1] Paul György, Donald B. Melville, Dean Burk and Vincent du Vigneaud, SCIENCE, 91: 243, 1940.

[2] Since this investigation was started, private information from Dr. du Vigneaud to one of us confirms the identity of vitamin H and biotin.

[3] E. E. Snell, Robert E. Eakin and Roger J. Williams, *Jour. Am. Chem. Soc.*, 62: 175, 1940.

By the eighth week, the usual syndrome had become very pronounced in the injured group, so the tissues of two chicks from each group were then assayed for their biotin content; two weeks later tissues from an additional chick of each group were tested. These tissues were allowed to autolyze under toluene for three days at 37° C., after which they were thoroughly extracted with hot water. The tissues from the injured chicks were found to be consistently lower in their biotin content than were those from the control chicks, as can be seen from the tabulation of the assay values (Table 1).

TABLE 1

BIOTIN CONTENT OF TISSUES IN γ PER GRAM

Diet: Age:	Injury 8 wks.	Injury 8 wks.	Injury 10 wks.	Control 8 wks.	Control 8 wks.	Control 10 wks.
Blood	0.0018	0.0021		0.0051	0.0067	0.0042
Liver	0.95	0.58	0.60	2.5	2.8	2.6
Kidney	0.45	1.3	1.0	1.9	1.8	2.5
Heart	0.018	0.041	0.036	0.11	0.033	0.11
Brain	0.025	0.029	0.044	0.067	0.018	0.065
Leg muscle.	0.008	0.016	0.015	0.027	0.018	0.033

These preliminary results indicate that the biotin which is present in the diet of the injured chicks (and which is more than sufficient in the absence of egg white) is not available to the tissues. Presumably it is destroyed by interaction with the egg white, and therefore an excess of biotin must be present in a diet containing egg white in order for the tissues to receive the necessary amount. It is probable that the injury caused by egg white is not due to any direct toxin, but rather is produced indirectly by the action of the egg white in making the biotin of the diet unavailable. If such is the case, it should be possible to produce similar syndrome by a diet which is actually deficient in biotin, but which contains no egg white.

We wish to thank Dr. T. H. Jukes for his kind cooperation in furnishing advice and certain materials for these experiments.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

MOLECULAR WEIGHT BY ISOTHERMIC DISTILLATION

OF all the solution methods for the determination of molecular weight of organic substances, the ingenious method of G. Barger[1] offers the widest applicability. This method is based upon the fact that a solution of higher molarity takes up solvent from a solution of lower molarity and *vice versa* until an equilibrium is reached. In a closed system, this produces changes in the volumes of a given standard solution of known molarity and the solution of the unknown substance but of known concentration. In practice, these changes in volume are determined by measuring at certain time intervals the diameter of several droplets contained in a sealed capillary and containing alternately the standard solution (st) and the solution of the unknown (s) in the same solvent which need not be pure (ethyl alcohol, pyridine, etc.). By appropriately choosing the molarity of the standard until the least changes are noted, the molecular weight of the unknown, the concentration of which, however, is known, may be readily calculated $\left(\frac{\% s}{M st}\times 10\right)$.

The greatest drawback of this method as well as its various modifications[2] is that the droplets, either in the filling operation or subsequently on standing, frequently undergo mixing, thus invalidating the determination.

It has now been found that this objection, namely—the mixing—is readily overcome by having the two solutions, the standard and the unknown, in two separate capillaries of about 7–8 cm in length and 1–1.5 mm in diameter (Fig. 1, A and B). The capillaries are filled by drawing up by suction the respective solutions, while they are open at both ends. Then the

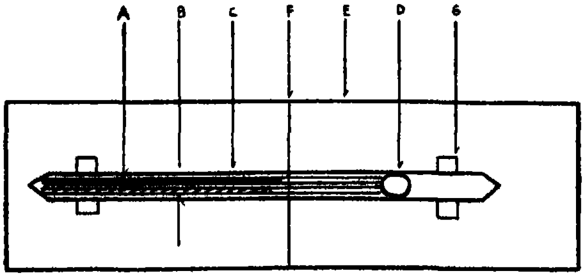

FIG. 1. Apparatus for isothermic distillation.

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[1] G. Barger, *Jour. Chem. Soc.*, 85: 286, 1904; *Ber.*, 37: 1754, 1904.

[2] J. B. Niederl and V. Niederl, "Micromethods of Quantitative Organic Elementary Analysis," pp. 184–186. New York, N. Y.: J. Wiley and Sons. 1938.

capillary orifice furthest away from the solution is sealed in a micro burner. After cooling, the solution is centrifuged towards this sealed end. The two capillaries thus filled are then placed in a suitable glass tubing about 10 cm in length and 5 mm in diameter (C). They are put in place by means of a wad of glass wool or cotton (D). The tube is then evacuated to about 15 mm pressure and is then sealed by means of an ordinary Bunsen burner. The tube may once more be subjected to centrifuging in order to have a clean-cut meniscus of each of the solutions contained in the capillaries. By means of adhesive tape (G) the tube is then attached to a rectangular glass plate, which is about 12 cm long and about 4 cm wide (E) and which possesses a hairline or a scratch across its width (F). The plate thus mounted is then placed into a water bath which is kept at room temperature to within ± 3° C. After four days, the distance between the two meniscii of the two solutions and the scratch, or hairline on the plate, is measured under a low-powered microscope possessing a micrometer scale in the eyepiece. These measurements are repeated subsequently once a day for a week. Thus it is easily ascertained which of the two solutions lost less solvent, this being the solution of higher molarity.

The molarities of the standard (azobenzene) employed are 0.05, 0.1 and 0.15 and the most suitable concentrations of the unknown sample are between 1 and 3 per cent. Differentiation between ± 0.01 molarities is possible.

The method described precludes any possibility of mixing of the two solutions and also permits the recovery and re-use of the unknown, while the results,[3] which will be published in detail in an appropriate analytical journal, compare favorably with the original Barger method or any of the known modifications thereof. The weighing out of the sample may be done on a macro, semi-micro or micro scale.

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ARTHUR M. LEVY

NEW YORK UNIVERSITY

A SIMPLE STAIN FOR TISSUE CULTURES

ANY one confronted with the necessity of staining hanging-drop tissue cultures grown in plasma has been impressed with the difficulty of securing a cytoplasmic stain which would not also tint the plasma of the clot to such intensity as to obscure largely the delicate cytoplasmic contours of the cells.

Many stains have been tried in this laboratory for coloring tissue cultures *in situ* in the plasma clot. The following simple method has given consistently good results on countless cultures over a period of nearly a year. It was developed to stain particularly cultures of brain tissue in which it reveals with a surprising clarity the finest processes of the cells as well as the nuclei and certain cytoplasmic inclusions.

METHOD

(1) Remove all paraffin and vaseline from the coverslip with cotton pledgets soaked in chloroform.

(2) Fix in 10 per cent. neutral formalin or absolute alcohol for 24 hours.

(3) Place in 1 per cent. aqueous solution of Toluidine blue for 1 hour.

(4) Wash in two changes of distilled water.

(5) Dehydrate in 85 per cent. alcohol 2–3 minutes.

(6) Place in 95 per cent. alcohol 2–3 minutes.

(7) Transfer to absolute alcohol until the clot contains little stain. This step may be controlled by watching the decoloration under a microscope. The differentiation takes 5–10 minutes.

(8) Clear in xylol.

(9) Mount in balsam or Nevillite.

JANE STANLEY CRAIG

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BOOKS RECEIVED

BARKER, LEWELLYS F. *Psychotherapy.* Pp. ix + 218. Appleton-Century. $2.00.

Carnegie Institution of Washington. *Miscellaneous Papers, XIV–XXI; Botany of the Maya Area.* Pp. 474. Illustrated. The Institution.

CARROLL, PAUL L. and WILFRED F. HORNER. *An Atlas of the Frog.* Looseleaf. Illustrated. Mosby. $1.25.

DEAM, CHARLES C. *Flora of Indiana.* Pp. 1236. Illustrated. Department of Conservation, Division of Forestry, Indiana. $3.50.

GALDSTON, IAGO. *Progress in Medicine.* Pp. 347 + xiv. Knopf. $3.00.

GERARD, R. W. *Unresting Cells.* Pp. xv + 439. 173 figures. Harper. $3.75.

HUME, EDWARD H. *The Chinese Way in Medicine.* Pp. 189. Illustrated. Johns Hopkins Press. $2.25.

LEACH, JULIAN G. *Insect Transmission of Plant Diseases.* Pp. xviii + 615. 238 figures. McGraw-Hill. $6.00.

PRODINGER, WILHELM. *Organic Reagents Used in Quantitative Inorganic Analysis.* Translated from the second German edition by STEWART HOLMES. Pp. xiv + 203. Nordemann. $5.00.

SCHILLETTER, JULIAN C. and HARRY W. RICHEY. *Textbook of General Horticulture.* Pp. ix + 367. 136 figures. McGraw-Hill. $3.00.

SWIGERT, ARTHUR M. *The Story of Superfinish.* Pp. 672. 720 figures. Lynn, Detroit.

The Changing Front of Health. Proceedings of the Eighteenth Annual Conference of the Milbank Memorial Fund, April, 1940. Pp. 104. The Fund, New York.

University Mathematical Texts: AITKEN, A. C. *Determinants and Matrices.* Pp. 135. *Statistical Mathematics.* Pp. 153; GILLESPIE, R. P. *Integration.* Pp. 126; INCE, E. L. *Integration of Ordinary Differential Equations.* Pp. 148; RUTHERFORD, D. E. *Vector Methods.* Pp. 127; TURNBULL, H. W. *Theory of Equations.* Pp. 152. Interscience Publishers, New York. $1.50 each.

VIGOUREUX, P. *Quartz Oscillators and Their Applications.* Pp. vi + 131. 86 figures. His Majesty's Stationery Office, London. $1.35.

WERKMEISTER, WILLIAM H. *A Philosophy of Science.* Pp. xii + 551. 29 figures. Harper. $4.00.

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[3] A. M. Levy, M.Sc. Thesis, New York University, Graduate School, April, 1940.

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CHEMISTRY WITHIN THE ATOM[1]

By Dr. S. C. LIND

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In our present age we have become accustomed to a continual acceleration in the development of all phases of human activity. A "Blitzkrieg" in international affairs is but one of the many manifestations of this acceleration.

In the realm of science, particularly in that of chemistry and physics, the rate of development has been no less phenomenal. It is not my purpose to discuss whether there is a direct relation between the two, or to try to determine what effect the advances of science have on our economic, social and political life, but rather to invite your attention to a portion of science which is so far removed from the world surrounding it that it has almost, though not wholly, escaped the attention of those who make wars. Its only applications to human affairs have been beneficent ones. You may well wonder what branch of science has enjoyed such isolation that it could not be twisted or abused to render disservice to mankind instead of service. You may be surprised that this oasis is at the heart of chemistry far inside the atom.

Paradoxical as it may seem, a half century ago, the inside of the atom was more unknown to us than the distant stars. I suppose the antithesis of a vacuum would be absolute solidity of matter. Such the atom was supposed to be. We know now how wide of the truth this conception has been found to be, but it required several years after the first messages from the interior of the atom before its structure began to be revealed.

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[1] Address of the president of the American Chemical Society, given at the centenary meeting, Detroit, Michigan, September 10, 1940.

It is not yet a half century since the first signals from far inside the atom were detected by Roentgen in the form of x-rays. Though the analogy is by no means perfect, one might say that they were the echo from the bombardment of inner electrons by electrons in electrical discharge in the form of cathode rays. The use of this terminology anticipates the actual discovery of the electron by J. J. Thomson which did not occur until two years later. And of course it was several more years before x-rays were identified as electro-magnetic pulses of short wave-length.

It was in 1896, the year between the discovery of x-rays and of the electron, that Becquerel discovered the first spontaneous messages from within the atom, spontaneous in the sense that they came without any external stimulation and had been coming undetected throughout the ages. Their emission is at the expense of the internal energy of the atom, which must be enormously great, both qualitatively and quantitatively. To this I shall refer again.

The spontaneous emission of energy from atoms takes three forms, the one like x-rays (γ-rays) another in the form of electrons (β-rays) and the third in the form of alpha rays (helium nuclei).

In 1898 Pierre and Mme. Curie discovered and separated radium. In 1902 Rutherford and Soddy announced spontaneous atomic disintegration to be the cause of radioactivity, the emission of rays or particles being the accompaniment of the disruption.

In the next few years there followed the discovery of about forty radioactive elements belonging to three different series or families, two of them having their origin in the previously known element uranium, in which Becquerel had just detected radioactivity, and the other from thorium, which Mme. Curie and Schmidt had independently discovered to be radioactive. These two elements are the primordial sources of natural radioactivity on the earth. Both have very long lives; otherwise they could not have persisted through geological ages. Neither of them is yet one fourth exhausted. Potassium should also be mentioned. Although but a feeble emitter of atomic energy, its great abundance in the earth's crust makes it an equally important geophysical source of energy.

The existence of the three radioactive series, each with a dozen or more successive genetically dependent members, is met only among the heavier atomic species. Although artificial radioactive species are now far more numerous throughout the entire range of atoms, heavy and light, the existence of genetic chains of any length is limited to the three natural series.

In 1912 Rutherford conceived the existence of the nucleus of the atom. It is quite impossible to overestimate the fundamental and far-reaching importance of this conception. It at once led to the Bohr hypothesis of electronic orbits and energy levels which afforded the key to spectroscopy. Only the neutron, found in 1932 by Chadwick, was needed to complete the picture of isotopes and the general ideas of atomic and nuclear structure.

But long before this in 1919 Rutherford had disrupted the nucleus artificially by alpha particle bombardment. This demonstrated that the nucleus could be attacked successfully from the outside as well as disrupted by its own internal forces.

But this artificial disruption still had to employ as its agent alpha particles from natural radioactive sources. It also lacked the most important characteristic of radioactivity. Its reactions were immediate. As soon as the bombarding agent penetrated the nucleus, disruption ensued without forming any intermediate product of definite life span. And this was found to be true although it was known that the alpha particle not only entered the nucleus but was permanently captured by it.

In 1933 Cockcroft and Walton, working in Rutherford's laboratory in Cambridge, made the atomic disruption completely artificial by employing, instead of the alpha particle from a natural radioactive source, the nucleus of the hydrogen atom or the proton, accelerated in a high voltage field obtained by the use of electrical transformers. This was soon followed by the invention of much more powerful and more convenient means of obtaining high fields—the cyclotron of Lawrence and the electrostatic generator of Van de Graaff. Also new projectiles were available in Urey's deuteron and the artificial alpha particles or helium nuclei. And as a by-product of certain bombardments or of some of the artificial radioactive reactions Chadwick's neutron was found by Fermi to be capable of entering any nucleus no matter how large or how great the nuclear charge. This possibility of course comes from the fact that the neutron having no electrical charge is not repelled on approaching a nucleus with positive charge proportional to its atomic number or the number of protons contained.

In 1934 artificial radioactivity was discovered by P. Curie and F. Joliot. In the bombardment of certain light nuclei by alpha particles they discovered intermediate products which continued to emit particles after removal from the source of bombardment. This was true artificial radioactivity for the first time.

The application of other bombarding agents—the proton, the deuteron, the slow neutron, the helium nucleus—soon followed with astonishingly fruitful results. More than seven hundred nuclear transformations have been brought about in practically all the atomic species. Nearly half of these nuclear reactions have produced new radioactive isotopes. About 20 classes of reactions have been established, based on the character of the projectile used and the type of the subsequent emission of particles and energy.

The new artificial radioactive atoms, like the older ones, undergo transmutation, accompanied by the emission of some kind of particle with or without a simultaneous emission of gamma radiation, into a stable isotope of a neighboring element. The lack of chain or series activity has already been mentioned. A greater variety of particle emissions is observed than in natural radioactivity: protons, positrons, deuterons and neutrons in addition to the alpha, beta and gamma emissions from the natural radioactive elements. In addition, the gamma radiation exhibits a much wider range of energy.

It is not too much to say that these reactions within the atoms, in the nucleus, present a wholly new field of chemistry. In the short space of five years ten times more artificial radioactive species have been produced and identified than we previously had of the natural kind, and this in spite of the fact that we have not had good means of detecting either the very short-lived or the very long-lived species like those which exist in nature. Of course the absence of other long-lived radioactive atoms in nature itself indicates that there are no others in any abundance with lives longer than the age of the earth, else they would, if existent, have survived and been discovered.

In this connection it is interesting to observe that nearly all the new artificial isotopes have sources that fit into the missing mass numbers among the known stable isotopes of any given atom. This is assuming that only one isotope of the same mass can have any existence in time. Or in other words, there can be only one stable nuclear structure made up of a given number of protons and of neutrons. While this rule that there can be no nuclear isomers is quite general, there are some definite exceptions which are becoming more numerous.

When one speaks of the atomic mass of any isotopic species of an artificial radioactive element, it is not implied that enough of any such element has been produced to measure the atomic mass by any means—not even by means of the mass spectrograph. The atomic mass of these new rare species is therefore a matter of deduction from a number of applicable principles, one of the most useful of which is the Einstein equation for the conversion of mass to energy or *vice versa*.

The relative atomic weights that are determined by the mass energy balance of Einstein represent by far the most refined atomic measurements that we possess. Their continued extension from the fourth to the fifth and sixth decimal places is no longer a matter of surprise.

When such a large quantity of energy is equivalent to so small an amount of mass as represented in the Einstein equation the determination of the energy even crudely suffices to give relative masses with extraordinary accuracy.

In all the nuclear reactions of atomic disruptions that we have discussed so far or that were known up to the beginning of 1939, the change in the nucleus was accompanied by the emission of particles of small mass, as electrons, a positron, a proton or a neutron; and only one of these for each atom disrupted. The alpha particle was the heaviest particle known to be emitted from the nucleus. In fact the amount of energy necessary for the ejection of a heavy particle from the nucleus would have been regarded as impossibly high.

Apparently no one had seriously considered the possibility that the nucleus might be split into two more or less equal parts; but that is exactly the interpretation of the reactions which certain uranium or thorium atoms undergo when the nucleus is entered by a neutron of slow speed.

In his studies of the action of neutrons on atoms of high atomic weight, Fermi had discovered that uranium atoms, as well as those of thorium, show exceptional behavior after their nuclei are pierced by slow neutrons, in that they exhibit radioactive properties accompanied by or consisting of a multiple emission of neutrons with extremely high velocity—three of the high-speed ones for one initial slow one. This represents a great gain or multiplication of energy at the expense of the intra-atomic energy. In addition there was a successive emission of electrons or beta particles.

It was at first thought that these phenomena could be interpreted as the production of a series of transuranian elements with atomic numbers 93, 94, 95, 96 and 97. Subsequently Hahn and Strassmann found that the new elements were not transuranian but were new radioactive isotopes of atomic number a little more and correspondingly a little less than half the original atomic number of uranium.

In these reactions the multiple emission of neutrons and the successive emissions of electrons both are understood if one recalls the ratio of neutrons to protons in normal atoms as a function of their atomic number or mass. In the light atoms the ratio is unity, one neutron for each proton as evidenced by the atomic mass being just twice the atomic number for the light atoms. With increasing atomic mass the ratio of neutrons to protons increases steadily and reaches the value 1.6 for heavy atoms like uranium. If then a heavy atom could be split into two nearly equal parts, each part would have a large excess of neutrons over protons and hence a tendency to get rid of neutrons. This can be done in two ways: either by their ejection from the nucleus, hence their multiple emission; or by their conversion into protons with liberation of electrons, hence the successive beta ray emissions. The result of the bombardment of uranium by slow-speed neutrons is the splitting of the atom, termed *fission,* with the production of some new radioactive elements about midway in the periodic system, and the liberation of an astonishingly high amount of energy.

It is the latter which has recently attracted attention as a possible source of intra-atomic energy that might be utilized as a practical source of power.

The multiplication of neutrons was found to be in the ratio of three emitted for one absorbed. Evidently if this should be continued into a chain process of any length the multiplication of energy liberated would lead to explosive reaction. It was even feared, under the supposition that ordinary atoms of U^{238} were responsible for the reaction, that it would be dangerous to have a large amount of pure uranium collected at one time and one place. This supposition could be set aside, however, in the light of the experience of the U. S. Bureau of Mines which at one time had and kept in Colorado for some years several tons of 100 per cent. uranium oxide without any unusual consequences.

The question then became whether one of the rarer isotopes of uranium might not be responsible for the behavior just discussed. Besides U^{238}, the common isotope of uranium, there are two others, U^{235}, long known as the head of actinium series which occurs in the proportion 1 U^{235} to 139 U^{238}; and U^{234} known in the uranium family as U_{II}, the immediate parent of ionium, with an abundance of 1 U^{234} to about 450 U^{238} or about 3 per cent. of the number of U^{235} atoms.

By a very skilful mass spectrographic separation of the gaseous ions of uranium tetrabromide, Nier obtained enough material to show in collaboration with Booth, Dunning and Grosse that it is the isotope U^{235} that is responsible for the remarkable multiplication of neutron emissions and of energy.

This discovery has led to much speculation as to the possibility of utilizing this material as a large source of power. Two questions arise. Is there enough of it and can it be obtained in a state of purity suitable for the proposed uses?

The first question can be answered readily in the affirmative. A very modest estimate of the radium production per year would be 10 grams of the element. Associated with this in nature is about 80,000 pounds of uranium. Of this, 1/139 part of 570 pounds would represent U^{235}. Since it is estimated that only five pounds would suffice for a very considerable power production, it is evident that the natural source is large enough to be very important.

The second question is: Can the isotope be separated from U^{238}? This is a problem to which the answer may not be so soon found. It seems agreed that the mass spectroscopic method used for separation in minimal quantities will not be applicable for such amounts as would be useful in power production. Only experimentation can show whether some other method may not be efficacious. It would be hazardous to predict that at some time in the future one or another method may not succeed.

One other question still might be pertinent: Admitting that it may be possible to obtain isotope U^{235} in quantities and at costs that make it available for practical power production, is it certain that the calculated amount of energy will be delivered and that it can be suitably controlled? The answer to this is necessarily highly speculative. The entire field is new. The methods of measurement, however, appear to be reliable and there seems to be no doubt of the energy emission when U^{235} is bombarded by slow-speed neutrons. This very fact, that it is the slow-speed ones which are effective in setting off the reaction but that high-speed neutrons are ejected, simplifies the control, at least theoretically. The presence of water slows down the high-speed neutrons so that the reaction becomes continuous and the excess energy absorbed by water is rendered available through its mediation. By withdrawal of the water the reaction is retarded or stopped. This seems simple enough for adequate control, but what practical difficulties may intervene in large-scale operation if and when we have pounds of pure U^{235} remains to be seen.

But whether or not the nucleus of the atom ever becomes an available source of intra-atomic energy, it has already furnished us one of the most interesting chapters of chemical science. A finer illustration of man's persistence and perspicacity can scarcely be found. The challenge of the atom has been met, the impenetrability of the nucleus has been conquered.

That these triumphs extend far beyond the bounds of chemistry and physics is well known to you all. The new elements are used as tracer elements in the fields of biology, botany, medicine and genetics. Even the age and energy of both the earth and sun are no longer mysteries.

But of greatest importance to the chemist is the new knowledge of atoms of different elements and their relation to each other. Prout's hypothesis has been more than justified. The Periodic System has been elucidated and extended. The nature of isotopes is no longer a mystery; even progress in their separation is being made.

It is well to keep in mind, however, that reactions resulting from bombardment occur in infinitesimally small amounts. A very small target is being shot at. Most of the projectiles fly wide of the mark. The neutron, however, has new and astounding properties of great promise. It must, however, be obtained through some nuclear reaction of bombardment with all the attendant inefficiency.

These difficulties, however, challenge but do not discourage the scientist. When he has once found the way to the nucleus, the heart of the atom, he will never give up until this new field of chemistry is in complete surrender to the scientific "Blitzkrieg."

OBITUARY

RAYMOND SMITH DUGAN

The death of Raymond Smith Dugan on August 31 deprives American astronomy of one of its best observers.

Born at Montague, Mass., on May 30, 1878, he was of Irish descent through his paternal grandfather, and from his mother received a Puritan inheritance going back to Myles Standish. His early training was characteristic of the New England village in which he lived, and led naturally to Amherst College, where he received his A.B. in 1899. Three years followed as instructor in mathematics and astronomy at the Syrian Protestant College at Beirut, and three more at Heidelberg with Max Wolf—where he discovered a considerable number of asteroids, including (508) *Princetonia,* (516) *Amherstia* and (535) *Montague,* and received his Ph.D. in 1905. Returning to America, he was appointed instructor in astronomy at Princeton, beginning an association of thirty-five years with that university, and with the writer.

The 23-inch equatorial and polarizing photometer of the observatory offered a field of research then new to him, in which he soon became a recognized authority, and continued active for his whole career. Realizing that precise observations are most valuable in cases which are capable of detailed discussion, he specialized on eclipsing variables, seeking to secure highly accurate light-curves for a few stars rather than provisional results for many. This involved great labor—for Z Draconis 1149 sets of 16 readings each—but the soundness of his judgment has been shown by the wealth of information regarding the dimensions, densities, forms, and even the internal constitution, of the stars which can thus be obtained.

Observations of such stars are a lifelong task, for many of them show slow changes in period, most of which are as yet unexplained, and unpredictable, and have to be followed year by year.

The discussion of his observations was made with equal thoroughness, making his monographs excellent reading for the student.

He was the first to detect the brightening of the faint companion on the side heated by the radiation of the primary—generally known as the "reflection effect."

His work was recognized by his advancement to the professorship at Princeton which he held for twenty years, by election to the American Philosophical Society, and as chairman of the Commission on Variable Stars of the International Astronomical Union. He was an active member of the American Astronomical Society and served as its secretary from 1927 till 1936 and vice-president from 1936 till 1938, to the great satisfaction of its members. In this position, and on the many occasions when he was acting director of the observatory at Princeton during the writer's absence, he showed excellent judgment, executive capacity and diplomatic skill.

He was a good teacher, especially of graduate students. A long series of these inspired by him shared in the photometric observations. In 1937, when he took account of the record, these had made more than 200,000 photometric settings and he himself 300,000.

He bore an important part in the preparation and revision of the text-book on astronomy, in which J. Q. Stewart and the writer shared.

No account of him would be complete without reference to his humor—a combination of Irish wit and dry Yankee shrewdness of expression—which crops out again and again in his reports as secretary and in his whimsical account of work in the old dome at Princeton,[1] which will rouse sympathetic chuckles from those who have never worked with what a student on examination once called a "refractory telescope" and deep memories in those who know the old place.

Shortly after the modern and convenient equipment of the new observatory became available he began to suffer from arthritis, which soon put an end to night work. He bore the physical suffering which followed with unbroken courage and the dry humor characteristic of him. Till within a few months, he continued active research, reducing his accumulated observations and working upon variations in period of eclipsing stars, with the aid of photographic data generously supplied from Harvard. The continued strain of his illness proved too much for his constitution, and the end came.

His widow, a sister and two adopted children survive him.

The writer can not close without an expression of his personal regret at the loss of a colleague with whom in the course of these many years there has never been any occasion of serious difference.

Henry Norris Russell

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[1] *Popular Astronomy,* 43: 146, 1935.

RECENT DEATHS

Dr. Hans Zinsser, professor of bacteriology at the Harvard Medical School, died on September 4 in his sixty-second year.

Dr. Phoebus Aaron Theodore Levene, member of the Rockefeller Institute for Medical Research from 1907 to 1939, died on September 6 at the age of seventy-one years.

Dr. Frederick Pattison Weaver, since 1925 professor of agricultural economics at the Pennsylvania State College, died on September 5 in his sixty-eighth year.

Dr. Maude E. S. Abbott, assistant professor of medicine at McGill University, died on September 2 at the age of seventy-one years.

William Lash Miller, head of the department of chemistry, University of Toronto, died on September 1 at the age of seventy-three years.

SCIENTIFIC EVENTS

THE HALL OF ETHNOLOGY OF THE MUSEUM OF NEW MEXICO

The Museum of New Mexico, Santa Fe, has been given, according to *Museum News*, the old Santa Fe Armory, adjoining the Palace of the Governors on Washington Avenue, and is remodeling it for use as a hall of ethnology. The property was assigned to the museum by act of the State Legislature, which also appropriated $10,000 for remodeling. The WPA is supplying the labor. Plans for remodeling, in the Pueblo style, were drawn by John Gaw Meem. The entire structure will be given over to ethnology. The entrance hall, 20 by 55 feet, will be arranged as a hall of man, with a series of life-size busts showing the evolution of the human race and a series of racial group busts, supplemented by an evolutionary series of implements and tools. The main exhibit hall, 50 by 75 feet and containing 3,750 square feet of exhibition space, will illustrate the living Indians of the Southwest and their cultural attainments. Through the center will be a series of models of Indian dwelling types and a kiva, with appropriate native life. Around three sides of the hall alcoves will contain exhibits of silversmithing and turquoise work, weaving, basketry, leather and bead work, ceremonial items, paintings, pottery, grinding and native economy and a typical pueblo room. Wall cases forming the alcove boundaries will carry charts, diagrams and photographs. In the alcoves Indians will carry out the pursuits of the alcove themes, a few at a time, for the double purpose of encouraging the Indians and showing visitors how things are actually done. A small room off this large hall will be used for special rotating exhibits of comparative material from the Americas. The second floor space will be used for the curator's office, private laboratory, office for assistants in the department, laboratory of physical anthropology and rest room. The full basement will contain a fireproof vault, dustproof storage for ceramic collections, two dustproof storage rooms for basketry and miscellaneous material, temporary storage for skeletal material from excavations, preparator's laboratory, janitor's room and public rest rooms. Out-of-doors at the back of the building will be a small placita with a modern Pueblo oven for baking bread and space for a pottery-firing kiln. Miss Bertha Dutton has been appointed curator in charge of the newly established department of ethnology.

GOVERNMENT POSITIONS UNDER THE CIVIL SERVICE COMMISSION

Applications must be on file by September 16 with the United States Civil Service Commission at Washington, D. C., for the position of assistant curator of ethnology in the National Museum, Smithsonian Institution, at a salary of $3,200 a year. An existing vacancy in this position in Washington and future vacancies in positions requiring similar qualifications will be filled from this examination, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer or promotion.

An examination to secure specialists in conference planning for the Office of Education is also announced. The salary is $4,600 a year. Applicants must have completed a 4-year college course and must have had administrative experience or highly responsible experience in organization work. In addition, they must have had experience in planning and conducting formal conferences, forums or other group activities for the purpose of discussion of public affairs. Writing experience in the field of education of adults in public affairs is also necessary. Examinations to secure personnel technicians for Government service cover the following grades: Personnel technician (test and measurements), $3,800 a year; also senior, $4,600 a year; associate, $3,200 a year; assistant, $2,600 a year, and junior, $2,000 a year.

Examinations are also announced covering two grades in naval architecture and marine engineering, as follows: Principal, $5,600 a year; senior, $4,600 a year. Applications may be filed until June 30, 1941. Qualified persons are urged to apply at once. Examinations for lower-grade naval architect and marine engineering positions were announced in June and the commission still is accepting applications for these positions.

Salaries in all cases are subject to a retiring reduction of three and one half per cent.

WORK OF THE NEW YORK UNIVERSITY COLLEGE OF ENGINEERING

SIXTEEN experts from the food and chemical industries will join with the faculty of the Graduate Division of the New York University College of Engineering this autumn in offering a new course in food engineering, which is one of the seventeen new courses to be given during the coming academic year.

According to Dr. Henry J. Masson, director of the Graduate Division and chairman of the department of chemical engineering, these courses will be conducted in the departments of administrative, chemical, civil, electrical and mechanical engineering and in the department of meteorology.

They are designed principally in accordance with the expressed needs of men employed in industrial and governmental work. The bulk of all graduate instruction at the college is offered in the evenings and on Saturdays, and combines advanced study with the practical experience and knowledge gained as a result of day-time occupations.

The course in food technology was developed after consultation with leading food technologists, many of whom will assist in teaching the course. It was based upon the concept of unit operations as developed by the chemical engineer, modified and adapted to the food industry. Lectures by industrial specialists will cover such topics as pasteurization, refrigeration, baking, packaging and bottling, canning, humidification and air conditioning.

Among the industrialists who will lecture during the course are: C. G. Segeler, American Gas Company; J. E. Guinane, Frosted Food Sales Corporation; C. A. Southwick, General Foods Corporation; C. O. Ball, American Can Company; Laurence V. Burton, *Food Industries,* and James A. Lee, *Chemical and Metallurgical Engineering.*

New courses in foundation engineering and soil mechanics will be offered by the department of civil engineering, in addition to other advanced courses in materials testing and model analysis. Polarized light will be employed in determining stress directions, while Beggs deformeter gages will be used on structural models.

Courses in the principles of audio-frequency, advanced radio-frequency and fundamentals of power system analysis will be added by the department of electrical engineering. The mechanical engineering department will add a course dealing with centrifugal pumps and compressors, while the department of meteorology will offer a new course in maritime meteorology and oceanography. Two new courses will be added by the department of administrative engineering covering production control and statistics. In addition to the course in food engineering the chemical engineering department will also add courses in mathematics as applied to chemical engineering and diffusional processes.

In cooperation with the Westinghouse Electric and Manufacturing Company, the division will also offer new courses covering industrial marketing, applications of electrical equipment and power system relaying.

THE DETROIT ZOOLOGICAL PARK

Museum News states that expenditures for improvements and additions to the Detroit Zoological Park under Federal work programs have cost $1,556,000 in allotments from the United States Government and $380,000 contributed by the park commission. New structures at the park completed in this building program include the administration building, the animal service building, the animal hospital building, hippopotamus building and exhibit, ostrich house, tiger exhibit and building, North American barnyard exhibit and building, South American mammal building and barless exhibit, South American pampas and buildings, African swamp exhibit enlarged and new building, monkey island, bear den and maternity cages, animal theater, aoudad rock and moats, beaver exhibit, trout stream with reservoirs and cascade, vegetable cellar of concrete and steel, and barless enclosures for alligators, reptiles and wolverine, raccoon and wolf. A log aquarium is in process of construction. Improvements were made in the North American plains exhibit; and the structure used formerly for a skunk exhibit was rebuilt for reptiles. For the railroad that encircles the park new stations, underpasses and a comfort station were completed. In addition, the wire enclosing fences were replaced with masonry walls; and sewers, water lines, paved walks and paved service roads were built. There are new entrance gates, new landscaping including the planting of hundreds of trees and new hotbeds for the greenhouses. John T. Millen is director of the park.

THE WOODS HOLE OCEANOGRAPHIC INSTITUTION

C. O'D. ISELIN, assistant professor of oceanography at Harvard University, director of the Woods Hole Oceanographic Institution, contributes an article to *The Collecting Net,* giving an account of the eleventh annual meeting of the Board of Trustees, which was held on August 15. Besides the ordinary routine business, the trustees voted to accept the *Anton Dohrn,* a gift from the Carnegie Institution of Washington. This 70-foot power boat was formerly used at the Tortugas Laboratory in Florida and will be converted during the coming winter for work in the coastal waters off New England.

The trustees discussed the rôle of modern oceanography in the movement towards increased national defense. It was agreed that the complete facilities of the institution should be offered to the National Defense Research Committee. Dr. Frank B. Jewett, a member of this committee and also a trustee of the Woods Hole Oceanographic Institution, explained how a closer cooperation between oceanographers and naval research could be achieved. While it still remains to be decided just which problems will be attacked first, it is clear that Woods Hole will soon become one of the headquarters for investigations of importance to the national defense and only rather remotely connected with oceanography in its ordinary sense. The retiring class of trustees was reappointed. These included Henry B. Bigelow, William Bowie, A. G. Huntsman, Alfred C. Redfield, Henry L. Shattuck and T. Wayland Vaughan. Dr. Vannevar Bush was elected a member of the corporation.

SCIENTIFIC NOTES AND NEWS

THE Leidy Medal of the Academy of Natural Sciences of Philadelphia has been awarded to Dr. Merritt L. Fernald, since 1915 Fisher professor of natural history at Harvard University and director of the Gray Herbarium. The medal is awarded in recognition of "outstanding contributions to the floristics of the eastern part of North America, including the Maritime Provinces and the Coastal Plain Region of the southern United States, and his correlations of the present-day distribution of plant life in North America with geologic history." The medal will be presented at a reception at the academy on September 17 by Dr. William B. Scott, emeritus professor of geology and paleontology of Princeton University.

THE University of Pennsylvania will confer twenty-one honorary degrees on September 21, when the Bicentennial Celebration Week will be brought to a close at a convocation in Convention Hall. Seven of the degrees will be conferred *in absentia* on European scholars who, although they will contribute papers to be read at a Bicentennial Conference during the celebration, will be unable to attend because of the war. Degrees conferred on scientific men are the doctorate of science on William M. Clark, director of the department of physiological chemistry, the Johns Hopkins University; Evarts A. Graham, Bixby professor of surgery, the School of Medicine, Washington University, St. Louis; Frank B. Jewett, president of the Bell Telephone Laboratories and president of the National Academy of Sciences; Wesley C. Mitchell, professor of economics, Columbia University; Charles S. Myers, formerly director of the Laboratory of Psychology, University of Cambridge (*in absentia*); Hermann Weyl, professor of mathematics, the Institute of Advanced Study, Princeton, N. J. The doctorate of laws will be conferred on Lawrence J. Henderson, professor of biological chemistry, Harvard University, and Herbert S. Jennings, professor of zoology, University of California.

DR. GEORGE BLUMER, since 1920 David P. Smith clinical professor of medicine at the Yale University School of Medicine, was guest of honor at a dinner marking his retirement from active service. Dr. Francis G. Blake, Sterling professor of medicine, was toastmaster. The speakers included Drs. Milton C. Winternitz, dean of the School of Medicine from 1920 to 1935, and Stanhope Bayne-Jones, dean from 1935 to 1940; William F. Verdi; Fu-ching Yen, a former student of Dr. Blumer and minister of health of the Republic of China, and Dr. James R. Angell, president emeritus of the university.

DR. ROBERT O. LAMBERT, associate director for the medical sciences of the Rockefeller Foundation, New York, was on July 14 the guest of honor at a dinner in San Juan given by former associates at the School of Tropical Medicine of the University of Puerto Rico, where he was for two years professor of pathology and the first director of the school.

DR. GORDON S. FAHRNI, of Winnipeg, was chosen president-elect of the Canadian Medical Association at the recent annual meeting in Toronto. He succeeds Dr. Duncan Graham, of Toronto, who became president.

DR. WOJCIECH SWIETOSLAWSKI, professor of chemistry and head of the Physico-Chemical Institute of the University of Warsaw, formerly Minister of Education of Poland, now chairman of the Committee on Physico-Chemical Data of the International Union of Chemistry, has been visiting professor of chemistry in the University of Pittsburgh since March. He becomes this month visiting professor of chemistry at the State University of Iowa, where he will remain until February.

DR. J. RICHARD WEISSENBERG, formerly professor extraordinarius of anatomy at the University of Berlin; in 1937 visiting professor of cytology at Washington University, St. Louis, and in 1939 member of the Wistar Institute, Philadelphia, has been appointed professor of histology and embryology at the School of Medicine of Middlesex University, Waltham, Mass.

DR. BERNHARD KURRELMEYER, associate professor in the department of physics of Brooklyn College, has been promoted to a full professorship.

DR. JOHN RINEHART, of the State University of

Iowa, has joined the staff of the department of physics at Kansas State College, Fort Hays.

DR. EDWIN B. ASTWOOD, associate in obstetrics at the Johns Hopkins University, will join the Harvard Medical School as assistant professor of pharmacotherapy. He will also be a member of the medical staff of the Peter Bent Brigham Hospital.

DR. EDGAR HULL, professor and head of the department of medicine of the Medical School of the Louisiana State University, New Orleans, has leave of absence from October 15 to May 15 of next year to accept a temporary appointment as associate professor of medicine at Yale University.

THE retirement is announced of Dr. David H. Newland, since 1927 state geologist at the New York State Museum, Albany, N. Y. Dr. Newland was assistant state geologist from 1905 until 1920, when he resigned to undertake private work in economic geology. He was appointed state geologist in 1927.

DR. G. A. ZENTMYER, JR., a member of the staff of the Bureau of Plant Industry of the U. S. Department of Agriculture at San Francisco, has been appointed research assistant in plant pathology at the Connecticut Experiment Station at Storrs. He will devote his time to investigations of the Dutch elm disease.

DR. J. WALLACE PAGE, JR., dual professor in chemistry and science education at Syracuse University, has been appointed director of the Maryland Academy of Sciences. Dr. Page organized and directed at Syracuse a center of science club activities of the American Institute of the City of New York.

DR. LOUIS B. FLEXNER, associate in anatomy in the School of Medicine of the Johns Hopkins University, has been appointed to the staff of the Carnegie Institution of Washington as research associate in the department of embryology, Baltimore. He will continue to investigate chemical interchanges in mammalian development, making use of artificially radioactive substances in cooperation with the Department of Terrestrial Magnetism of the Carnegie Institution. Dr. Herbert A. Pohl has been appointed as research assistant in the department of embryology and Dr. Alfred Gellhorn a research fellow. Dr. Inez Colombo de Allende, during the past year traveling fellow of the Argentine Association for the Advancement of Science at the University of Rochester, has been appointed to a Rockefeller traveling fellowship and will spend the year 1940–41 at the department of embryology of the Carnegie Institution.

DR. ARTHUR K. PARPART, assistant professor of physiology at Princeton University, has been appointed director of the course in physiology at the Woods Hole Marine Biological Laboratory for 1941. He succeeds Dr. Laurence Irving, professor of biology at Swarthmore College and director of the Edward Martin Biological Laboratory.

DR. GLENN W. PARSONS, assistant professor of chemistry at the University of Mississippi, has become associated with the Chemical Division of the Procter and Gamble Company, Ivorydale, Ohio.

DR. EDWARD WIGGLESWORTH, for twenty years director of the Boston Society of Natural History, has resigned to become Eastern director of the Gemmological Institute of America and chairman of its educational advisory board. The gemmological laboratory at 69 Newbury Street, Boston, will be under his direction. This is the second gemmological laboratory of the institute, the first having been conducted in Los Angeles since 1933.

R. D. MACCART, chief engineer of the Brewster Aeronautical Corporation, has been elected vice-president of the corporation in charge of engineering.

PROFESSOR M. S. COOVER, head of the department of electrical engineering at the Iowa State College, has been appointed secretary of the division of electrical engineering of the Society for the Promotion of Engineering Education and also a director of the American Institute of Electrical Engineers.

A RESEARCH grant has been extended by the Committee on Scientific Research of the American Medical Association in aid of the researches of Professor Chas. W. Greene on the coordinations of the coronary circulation. These investigations are being carried out in the physiological laboratories of Stanford University.

THE department of chemistry of the University of Pittsburgh has received two grants for post-doctorate fellowships. The first from the Carnegie Institution of Washington for the study of heats of dilution has been awarded to Dr. William E. Wallace, of Mississippi College and the University of Pittsburgh, who will be associated with Dr. A. L. Robinson. The second fellowship, which is from the John and Mary R. Markle Foundation, has been awarded to Dr. Richard H. McCoy, of the University of Illinois, who will engage in biochemical research under Dr. C. G. King, professor of biochemistry.

DR. FRANKLIN G. EBAUGH, professor of psychiatry of the School of Medicine of the University of Colorado, Denver, will deliver the Rogers Memorial Lecture on September 19 on "Our Mental Health."

DR. LEWIS KNUDSON, professor of plant physiology at Cornell University, spoke on August 22 before the newly formed Puerto Rico Orchid Society on "Orchid Seed Germination"; and on August 24 he spoke before the staff of the Puerto Rico Experiment Station of the

U. S. Department of Agriculture on "Environmental Conditions Favorable for Orchid Culture."

THE dedication exercises of the Administration Building of Bellevue Hospital, New York, were held on September 11. Dr. S. S. Goldwater, commissioner of the department of hospitals, presided. The speakers were Dr. I. Ogden Woodruff, representing the Medical Board; Dr. William F. Jacobs, medical superintendent; Mrs. Henry James, president of the Board of Managers of the Bellevue School of Nursing; Colonel E. W. Clark, *commissioner of public work*, Federal Works Agency; Hon. Irving V. A. Huie, commissioner of the department of public works, New York, and the Hon. F. H. LaGuardia, mayor of the city.

THE New York Medical College and Flower and Fifth Avenue Hospitals will receive $242,531, the residue of the estate of Mrs. Helen S. Case, who was the wife of the late Major James F. Case, mining engineer.

THE Rockefeller Foundation of New York City has made an appropriation to the Iowa State College of $21,000 to be used over a period of three years for work under the direction of Professor J. W. Gowen, of the department of genetics, on bacterial wilt of corn and mouse typhoid.

THE Illinois Institute of Technology, Chicago, has for the academic year 1940–41 received two fellowships of $900 for graduate study established by Universal Oil Products for work in the catalytic laboratory under the direction of Dr. Vasili I. Komarewsky.

THE General Education Board, New York, has given the University of California Institute of Child Welfare a grant of $61,700 for the continuation of studies on the mental and physical development of children.

Museum News reports that the collection of the Daniel B. Dyer Museum, which occupied four rooms in the basement of the Kansas City Public Library, has been assigned to the Kansas City Museum as a result of a decision by the circuit court. The collection was in custody of the Board of Education, which asked to be relieved of the trusteeship. The material transferred comprises American Indian, including mound builder and cliff dweller, material; Mexican and Oriental objects; Spanish-American war material; coins and medals; small fossils; minerals; glass, china and copperware.

DISCUSSION

APPARENT SPLITTING OF LIGHT FROM FLUORESCENT LAMPS BY REFLECTION FROM THIN PLATES

ATTENTION was recently directed to the apparent splitting of light from fluorescent lamps by moving objects.[1] This phenomenon was attributed to the intermittent emission of light of different wave-lengths. The latter characteristic has been described in detail by Fonda[2] and by Thayer[3] upon the basis of the time intervals between the mercury discharge and the different periods of excitation and decay of the "phosphors" coating the tube. A qualitatively different kind of splitting of this light has been noted incidental to the use of an oscillometric device consisting of a microscope slide separated by a thin wedge of air from a glass cover slip.[4] When pressure is applied to the thin slip the wedge is diminished in thickness so that on being viewed in ordinary white light from such sources as the sun or incandescent lamps colored interference bands or Newton's rings are seen. If the light is filtered through colored glass the interference bands are somewhat more clearly evident. When, however, the device is illuminated by light from fluorescent lamps still greater sensitivity is secured in that lesser increments of applied pressure are required to produce the first visible bands. On close inspection a double set of bands can be recognized. One of these varies with alternations of pressure; the other remains constant. The variable pattern is produced by the changing distances between the reflecting surfaces. The fixed pattern is produced by the cover slip alone, the slide showing no separation of the light. The production of interference patterns by reflection of ordinary white light is recognized only with much thinner plates, *viz.*, of the magnitude of oil films and soap bubbles. In contrast, the comparatively thick plates, glass cover slips from approximately 0.10 mm to 0.18 mm (No. 0 to No. 2), show definite patterns in fluorescent light. The bands produced by illumination from the "Daylight" lamp are red, yellow and blue. The bands are broad and few in number with the thin slips and comparatively narrow in number with the thicker slips. When viewed from comparatively larger angles and distances, microscope slides show similar colored bands. The general contour of the patterns is comparable to that produced by reflection of light from the sodium flame. Similar phenomena are recognized with other thin materials. For example, sheets of mica exhibit colored patterns consisting of wide bands, and Cellophane reveals on close examination fine streaks of color due to the irregular thickness of the film. The appearance of interference colors by the comparatively thick plates in fluorescent light is due, not to the intermittent flashing, but to the discontinuity of the spectral quality of the components of the light. The latter, *viz.*, that of the mercury discharge and of the various "phosphors" have individually fairly limited spectral ranges. The patterns are comparable to those which would be produced by the mixture of a few essentially monochromatic lights. It is apparent that illumination by fluorescent lamps provides a convenient means for estimating the relative thickness and the optical regularity of the reflecting surfaces of thin plates. It is further evident that such lamps provide a readily available source of light for interferometric devices.

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[1] C. Wesler Scull, C. G. Grosscup and E. G. Witting, SCIENCE, 91: 357, April 12, 1940.

[2] G. R. Fonda, SCIENCE, 91: 476, May 17, 1940.

[3] R. N. Thayer, SCIENCE, 91: 524, May 31, 1940.

[4] C. Wesler Scull, *Jour. Lab. Clin. Med.*, 24: 753, April, 1939.

C. Wesler Scull

Abington Memorial Hospital,
Abington, Pa.

EXISTENCE OF ONLY ONE VARIETY OF CULTIVATED MANGOSTEEN EXPLAINED BY ASEXUALLY FORMED "SEED"

The luxurious flavor, beauty and texture of the fruit of the mangosteen, *Garcinia mangostana*, makes it, in the opinion of most people who know it, the best of the tropical fruits. A great deal has been published about this Asiatic species, especially concerning the difficulty which in general is attributable to poor root growth of growing plants through the juvenile stage.

Examination of the normal shriveled anthers in many flowers from two 37-year-old trees at the Puerto Rico Experiment Station of the United States Department of Agriculture has shown no pollen to be present. These female trees are reproduced through "seed" without the presence of the functional male flowers that are borne on separate trees, none of which exist in Puerto Rico. Backer[1] in 1911 stated that male flowers of the mangosteen had nowhere been found during the last hundred years. Descriptions of the male flowers that were, nevertheless, dated during that one-hundred-year period[2, 3] or more recently[4] have been studied. Backer's description[3] is admittedly based upon Roxburgh's, and that of Ochse also corresponds closely to Roxburgh's. Thus it appears that all are based upon Roxburgh's description. Whether that was made from living or herbarium specimens is not indicated. Backer's statement that male flowers had not been found within one hundred years leads, therefore, to the assumption that Roxburgh's description was probably based upon herbarium, not living, specimens. Study of these descriptions leaves no doubt about the male flowers being distinct from the female flowers of the Puerto Rican trees.

About half of the fruits produced by these trees have well-developed "seeds," each fruit rarely having more than one. A longitudinal section of this "seed" shows a structure much different from that of the normal dicotyledonous seed. The "seed" formation in the cultivated mangosteen is asexual. Sprecher[5] explained this freakish asexual reproduction mechanism in the mangosteen and called it apomixie. As he describes it, the adventitious embryo that develops to form the "seed" originates from a cell in the epithelium of the ovary inner integument. The reproduction is thus distinguished from nucellar budding that occurs in the apogamic reproduction in the mango and in Citrus. As the cell of the inner integument develops into a papilla and further to form the seed the nucellus and the embryo sac become nonfunctional. Similar adventitious embryony has been observed by Hegelmaier in *Allium odorum*.[6] Sprecher called the "seed" a hypocotyl-tubercle. According to him and Pierre[7] no traces of radicle, stem or cotyledons are present in the "seed." A similar structure has been observed at the Puerto Rico Experiment station in "seeds" of *Rheedia brasiliensis* and *R. macrophylla*.

Descriptions of mangosteen fruits from Java, Malaya, Trinidad and elsewhere conform precisely to the fruits produced in Puerto Rico. It would therefore seem that different varieties of the cultivated mangosteen do not exist. Fairchild,[8] traveling extensively in the Tropics studying the mangosteen, has stated that there are apparently no varieties of this fruit tree; seedlings everywhere bear curiously uniform fruits. Burbidge[9] in 1887 saw in British North Borneo what he considered a native form of the mangosteen. Fruits of this differed from those of the cultivated form, being 4-carpellate, each carpel having a well-developed seed, while in the cultivated form there are from four to eight carpels, rarely more than one or two of which develop "seed." Wester[10] describes the Jolo mangosteen as being rather larger than those of Singapore and Saigon and as having a thicker rind. Its flesh, too, is more acid and has more character than the milder flavored fruit of the Malay Peninsula and Java. Its seeds are said to be larger. Such differences might be due to environment.

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[1] C. A. Backer, "Schoolflora voor Java," p. 91. Batavia: N. V. Boekh and Visser and Company. 1911.

[2] William Roxburgh, "Flora Indica," 2: 618–620. London: Parbury, Allen and Company. 1832.

[3] C. A. Backer, "Flora van Batavia," pp. 84–85. Batavia: G. Kolff and Company. 1907.

[4] J. J. Ochse, "Fruits and Fruitculture in the Dutch East Indies," pp. 53–54. Batavia: G. Kolff and Company. 1931.

[5] M. Andreas Sprecher, *Rev. Gen. Bot.*, 31: 513–531. 1919.

[6] F. Hagelmaier, *Bot. Zeitung*, 55: 133–140. 1897.

[7] M. E. Pierre, *Bul. Mensuel Soc. Linn. de Paris*, 1: 350. 1882.

[8] David Fairchild, "Exploring for Plants," p. 392. New York: The Macmillan Company. 1930.

[9] F. W. Burbidge, *Gardeners' Chronicle*, n. s., 21: 23, 1884.

[10] P. J. Wester, *Philip. Agr. Rev.*, 13: 50, 1920.

Aside from these two notes, no mention of other mangosteen variations has been found in the literature.

This unusual asexual reproduction in the cultivated mangosteen accounts for the curious uniformity in its fruits wherever grown, and this famous fruit seems to be of one variety only.

Further anatomical studies of the mangosteen flower, fruit and "seed" are being continued at the Puerto Rico Experiment Station of the U. S. Department of Agriculture.

CLAUD L. HORN
PUERTO RICO EXPERIMENT STATION
OF THE U. S. DEPARTMENT OF AGRICULTURE,
MAYAGUEZ

AND/OR OR ANDOR

THE use of the form "and/or" in legal practice is well established. In recent years I have noticed an increasing tendency for writers of scientific papers to make use of it. The question of the need for such a form of expression I do not wish to raise here, but the presence of a symbol of this kind upon the printed page gives to it an untidy, unfinished and objectionable appearance as though it were marked copy subject to revision.

The thought has long plagued me that in view of the apparent absence of any word in the English language of "andor" such a word might well be introduced and defined to convey the precise meaning of "and/or" and thus clear the page of the unnecessary and unsightly virgule which mutilates the typed line.

This subject may be enlarged upon to great length and an extensive review made of numerous past diatribes against the use of "and/or." My purpose here is to bring to attention a suggestion for such consideration as it may merit.

WALTER B. LANG
WASHINGTON, D. C.

WHAT IS SUMMER?

AT this time of year one often reads among scientific notices that the summer solstice occurred at 2:35 P.M. on June 21, or at some other time as the case may have been, and that this event marked the *beginning of summer*. The local paper enlarges on this news item, leaving out the solstice idea, the editor not being quite sure what the term means, but announcing, in language borrowed from the births column, that summer arrived yesterday afternoon at 2:35. Sometimes the paper says that summer then began "officially," and attributes the determination of the time somewhat vaguely to "the astronomers." Analogous notices appear about December 21, when we are told that winter "came in" at 7 A.M., mildly or violently as the weather may have determined. The same oracle announces at the equinoxes the "official" beginnings of spring and fall. With this idea, that summer and winter begin at the solstices, and spring and fall at the equinoxes, I absolutely disagree, and, as Chesterton says, with a peculiar ferocity.

Certainly the equinoxes occur about March 21 and September 21, and at those moments the center of the sun is in the plane of the earth's equator. Then the nearest day and night are equal (except for a possible difference too small to be noticed) all over the earth, except at the poles, where the sun may be seen on the horizon. Certainly at the summer solstice we have the longest day of the year, and the sun at noon is higher in the sky than at noon on any other day. Certainly, then, land and sea and air, in our latitudes, are gaining heat most rapidly. But I do not think that summer begins then. June 21 is not the beginning of summer, and no one, by calling it the beginning officially, can make it so.

In the first place, our government can not determine what a common word is to mean. Also there is no "official" whose duty it is to define the names of the seasons, and if there were such an official he could not perform that function. A government astronomer, I suppose, determines the time of the solstice. His work ends when that is done. Writers, editors and calendar makers, wishing to dramatize the event, announce it as the birth of the season, which it is not.

Summer in the Saxon English which we speak by inheritance means the warm season. A dictionary definition is "the hottest or warmest season of the year, including June, July and August in the northern hemisphere." For convenience we make it correspond to whole rather than fractional months. In these latitudes this is reasonable, too, because about July 20, near the middle of these three months, is the hottest time of the year. Further north, of course, the peak of summer is earlier, and it is still more absurd to say that it begins on the longest day. June 24 is Midsummer Day in old English custom, the Feast of St. John the Baptist. You could not tell a farmer that the longest day is the beginning of summer. He would know better. Moreover, so people have written English in poetry and prose. "No price is set on the lavish summer, June may be had by the poorest comer." June, not just June 21 to 30. The period from summer solstice to autumnal equinox is obviously not summer.

It might indeed be convenient to have a term for that period. Such a term should not do violence to nature and the common meaning of useful words. We could call it the third quarter. Then the second quarter would be the time from the vernal equinox to the summer solstice. In this way the first quarter of this year would take in a few days—December 21 to December

31—of last year, and this is awkward. We stupidly begin our year at an arbitrary and unreasonable time. It is as if we passed the solstice without recognizing it, and only began our year when, ten days late, we first noticed the lengthened day. But the quarters are reasonable divisions, marked with astronomical precision, and not to be designated by terms already in use with a different meaning.

I resent the arrogance of those who say that the everyday and historic meaning of a common word is wrong. They are like those small girls who read Emerson's poem, "The Mountain and the Squirrel," in their fourth readers, and noted that he referred to the squirrel as bun. They announced at once that we were wrong in using bunny to call our pet rabbit. We grant now that the solstice comes on June 21, and we know what the word means. We do not think the solstice marks the advent of summer, and we will not use the word summer to denote the third quarter of the year.

W. W. SLEATOR

UNIVERSITY OF MICHIGAN

SCIENTIFIC BOOKS

SIR JOHN CUNNINGHAM MCLENNAN

Sir John Cunningham McLennan, a Memoir. By H. H. LANGTON. With a chapter on his scientific work by E. F. BURTON. Toronto: University of Toronto Press. 1939. $2.50.

THE biography of a scientist and a man of great achievements is always welcome and of interest. In this age of the dominance of physical science (a true luxury age for the physicist) in the light of things that have been and perhaps in the light of the days to come, the biography of a man like Sir John is of more than passing interest. Very few of the modern generations of physicists realize what were the conditions in our laboratories in the western hemisphere less than fifty years ago. It is to the sterling leadership, the untiring enterprise and zeal and the scientific idealism of men like Sir John C. McLennan that we owe the present status of research and learning in North America. Starting in an impoverished and lay community with no support and little encouragement Sir John in some thirty years educated this community to a true appreciation of science, built one of the leading physical research laboratories in North America and contributed his share to the fund of knowledge. How this was done and how Sir John himself developed as a physicist is covered in the first chapters of the book, which essentially mark episodes in his life under the titles, "Early Life," "The Department of Physics," "The Alumni Association" and "The Physics Laboratory." The subsequent episodes in this rich and active life are "The War," "Research, Public and Academic Activities after the War" and "The Last Years." In view of the present world situation the relations of science to national defense as illustrated by the activities of Sir John furnish valuable reading. It may be of interest to point out that the magnetic mine so much discussed in recent months was invented and developed as an anti-submarine measure by Sir John. With these mines placed in defensive positions there were gotten one enemy cruiser, three destroyers, three mine sweepers and two submarines. Incidentally, one of these submarines had successfully negotiated all defenses in the entrance to Scapa Flow only to blow up on Sir John's magnetically controlled mine, thus saving the fleet anchored there serious losses.

An Appendix by Professor E. F. Burton lists the scientific achievements of Sir John. Of these the most valuable were some of his early researches on electrical discharge in gases, the discovery of the earth's penetrating radiation and the isolation by means of an ice ionization chamber on Lake Erie of what is now called the cosmic radiation, the studies on spectra and ionization potentials, the successful construction of the world's second cryogenic laboratory and his discovery of the origin of the green auroral line. In a final Appendix there is a complete list of Sir John's published works.

The biography is historically accurate and well documented. The style is terse but readable, the material is well organized, and the contents are largely factual. No attempt at character analysis is made, although a chapter entitled "Characteristics" describes Sir John in terms of the author's impressions and quotations from his contemporaries.

LEONARD B. LOEB

THE MICROSCOPE

The Microscope. By ROY M. ALLEN. iv + 286 pp. 82 figs. 17 plates. New York: D. Van Nostrand Company, Inc. 1940. $3.00.

BOOKS dealing solely with the microscope in general are fairly numerous; those that cover the subject and further attempt to describe methods of preparing materials for microscopical examination are less common. The text under review belongs in the latter category despite the statement in the preface that it is "devoted wholly to the theory and manipulation" of the microscope. Actually, however, only 177 of the 286 pages are strictly devoted to microscopes and their operation.

The author, a consulting microscopist and former president of the New York Microscopical Society, explains in considerable but not belabored detail the optical principles involved in the construction and operation of all the different types of microscopes. The explanations are designed for persons possessed of little knowledge of the optical and mathematical laws involved and are clearly understandable. The information presented has been derived from many sources, and the book thus constitutes a useful and handy reference manual. Instruments of American manufacture are almost exclusively discussed.

In the preface the claim is further made that "the methods and techniques of mounting described represent actual practice originated and developed in the author's own laboratory." The sections devoted to petrological and metallurgical procedures are good, but those dealing with biological materials are somewhat disappointing. The invaluable microtechnique journal, *Stain Technology*, is nowhere mentioned; it is unfortunate that the author could not have utilized it as a source for more modern and dependable methods.

While perusing this book and comparing it with others of a similar nature, the reviewer was struck by the fact that none of these texts has ever achieved a real and satisfactory balance in the treatment of the two phases of the subject. It is a somewhat curious fact that the writers of all such texts seem to be better grounded in the theory and operation of the microscope than in the principles and procedures of general microtechnique. Discussions of technical methods have always been inadequate, lopsided and oftentimes prejudiced.

The book is excellently printed on a thick white stock. The language is somewhat stilted and occasionally makes difficult reading. A few sentences whose meaning is incomprehensible occur (*e.g.*, the last sentence of the second paragraph on page 179). Although it is a minor point in a book apparently intended primarily for amateur microscopists desiring to know more about their instruments, citation of scientific names and terminology does not consistently follow accepted usage. For example, on page 217 are found "spiragyra" and "mycellium." And there is the statement that the staining solution of Heidenhain's iron hematoxylin is "a saturated solution of hematoxylin in water, which requires a week or two to reach saturation" (p. 228).

There is a clearly reproduced color frontispiece and 17 plates of photomicrographs, mostly, as might be expected, of diatoms. Appended is a bibliography of selected references, a glossary of microscopical terms and an index.

DONALD A. JOHANSEN

STANFORD UNIVERSITY

SOCIETIES AND MEETINGS

THE ALABAMA ACADEMY OF SCIENCE

UNDER the auspices of President George D. Palmer, of the School of Chemistry, Metallurgy and Ceramics of the University of Alabama, the Alabama Academy of Science held its seventeenth annual meeting at Birmingham-Southern College, Birmingham, on March 29 and 30, with an attendance of over one hundred and twenty-five members and many visitors. The progressive Alabama Junior Academy of Science held its eighth annual meeting at the same time and place, Artie Belle Pirtle, Sidney Lanier High School, Montgomery, presiding, attended by one hundred and ninety-four delegates from twenty-seven high schools.

The usual executive and business meetings were held on Friday, and the scientific papers were presented in two sessions, on Friday afternoon and Saturday morning, and in four sections, the four vice-presidents serving as section chairmen. These were, respectively, S. R. Damon, Biology and Medical Science, State Department of Health, Montgomery; I. M. Hostetter, Chemistry, Physics and Mathematics, Howard College, Birmingham; A. J. Westland, Geology, Anthropology and Archeology, Spring Hill College, Mobile; and E. D. Emigh, Industry, Economics and Geography, Weather Bureau, Montgomery. A demonstration on the induction of ovulation by pituitary stimulation, showing the use of this technique in teaching and research, was given in Ramsay Hall by C. M. Pomerat, chairman, Department of Biology, University, as was one on plastics and synthetics by the president. Junior Academy exhibits were held in the same building. All business sessions were held in Munger Hall. A complimentary luncheon was tendered the scientists by the college in the cafeteria, and a tea was given for members of both academies and visitors in the Stockham Building. At the annual banquet, Walter B. Jones, director, Alabama Department of Conservation, Montgomery, served as the very able toastmaster. He later presented to the academy "The Ivory-Billed Woodpecker," a motion picture film, at the joint session in the evening over which he presided. This was held in Munger Auditorium. George R. Stuart, assistant to the president of the college, gave the address of welcome, and the response was made by S. J. Lloyd, dean of the School of Chemistry, Metallurgy and Ceramics, University, and acting state geologist. Dr. Palmer's presidential address was entitled "Scientific Research, the Hope of the South."

One morning and two afternoon field trips for the academy were arranged by Russell L. Poor, chairman of the Geology Department, Birmingham-Southern College, for Saturday. Much of interest was revealed in the Red Mountain and Shades Mountain regions, in the blast furnaces and coke ovens, as well as in the beautiful residential areas of Mountain Brook and the Country Club.

Reports of special interest at the business session were made by John Xan, Howard College, Birmingham, treasurer; J. H. Coulliette, Birmingham-Southern College, councilor of the American Association for the Advancement of Science, and E. V. Jones, Birmingham-Southern College, editor of the journal. Three new committees functioned for the first time. These were: (1) Committee on Promoting Membership and Activities, Walter B. Jones, *chairman;* the Committee on Research, S. J. Lloyd, *chairman;* and (3) the Committee on Publication, under the chairmanship of E. B. Carmichael, of the Medical School, University, with the editor serving as *ex-officio* member.

The American Association for the Advancement of Science grant-in-aid of research was renewed for another year to J. Allen Tower, Birmingham-Southern College, for continuation of his work on the "Preparation of an Atlas and a Geography of Alabama." The committee was composed of the president-elect, C. M. Farmer, chairman, and the four vice-presidents. Two honorary members were elected, namely, Wright A. Gardner, Auburn, founder of the academy, and John Y. Graham, for forty-two years chairman of the department of zoology at the university, who retired last year, now emeritus professor of zoology. The members voted to establish an academy statistician, a permanent director of exhibits and demonstrations and to expand the sections to seven, including Physics and Mathematics in a separate section from Chemistry, and adding one on Geography, Conservation and Allied Subjects and one on the Teaching of Science. James L. Kassner was retained for one more year as acting permanent counselor of the Junior Academy, to be assisted by two academy members. Sustaining memberships were acted upon favorably, as was a suggestion by the president that steps be taken at the next annual meeting to organize a Southeastern Scientific Society. The academy received an invitation to meet with Howard College in 1942 in connection with the Centennial Celebration of that school. The 1941 meeting will be held at Spring Hill College, Mobile. Following the report of the various committees and the expression of appreciation to the officers and the host college upon the completion of business, the meeting adjourned.

New officers for 1940–1941 were elected as follows: *President,* C. M. Farmer, State Teachers College, Troy; *President-Elect,* Paul D. Bales, Howard College; *Vice-Presidents* and *Section Chairmen,* H. D. Jones, Biology and Medical Science, Alabama Polytechnic Institute, Auburn; Lindsey M. Hobbs, Chemistry, University; David L. DeJarnette, Geology, Anthropology and Archeology, Alabama Museum of Natural History, University; J. Allen Tower, Geography, Conservation and Allied Subjects, Birmingham-Southern College; W. A. Moore, Physics and Mathematics, Birmingham-Southern College, and Claustie E. McTyeire, The Teaching of Science, Hueytown High School, Bessemer. The chairman of Industry and Economics is to be appointed. Miss Winnie McGlamery, Geological Survey, University, was selected as secretary to succeed the present secretary, who has served for five years. J. H. Coulliette, Birmingham-Southern College, councilor of the American Association for the Advancement of Science, was reelected. The terms of office of the treasurer, John Xan, Howard College, and of the editor, E. V. Jones, Birmingham-Southern College, continue for one and two more years, respectively.

Septima C. Smith,
Secretary

SPECIAL ARTICLES

TIME COURSE OF PHOTOSYNTHESIS AND FLUORESCENCE

When a plant is exposed to light after a dark period, photosynthesis (as measured by uptake of CO_2) gradually comes to its full rate during a short interval called the induction period. Changes in intensity of the fluorescence of chlorophyll of the plant during this time have been interpreted[1] in terms of photochemical processes. Experiments are in progress in the Division of Radiation and Organisms of the Smithsonian Institution for the simultaneous measurement of the rate of uptake of CO_2 and intensity of fluorescence during the induction period.[2] These measurements confirm the usefulness of fluorescence observations as a tool in the study of photosynthesis.

The rapid spectrographic method of CO_2 measurement previously used[3] has been adapted to a constant-flow technique with a rapid time response. The Mazda illumination was limited by filters to < 6400 Å (intensity: 60×10^4 ergs/cm.^{2}/sec.). Intensity of fluorescence was measured with a filter-photocell combination responding only to radiation > 6500 Å. (Fluorescence of chlorophyll *in vivo* falls in the region between 6500 and 8200 Å.)

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[1] J. Franck and R. W. Wood, *Jour. Chem. Phys.,* 4: 551, 1936; H. Kautsky and R. Hormuth, *Biochem. Zeits.,* 291: 285, 1937; E. C. Wassink and E. Katz, *Enzymol.,* 5: 145, 1939.

[2] E. D. McAlister and Jack Myers, *Smithson. Misc. Coll.,* 99: (6), 1, 1940.

[3] E. D. McAlister, *Smithson. Misc. Coll.,* 95: (24), 1, 1937; *Jour. Gen. Physiol.,* 22: 613, 1939.

Solid lines on the curves are tracings of original records (upper: intensity of fluorescence; lower: rate of CO_2-uptake. The dot-dash lines (—.—.—) represent the probable course of CO_2-uptake in the plant during the first seconds of illumination, obtained by correcting the recorded curve for the time lag of response of our instruments (6 seconds [wheat] to 15 seconds [*Chlorella*]).

When wheat is suddenly exposed to high light the burst of fluorescence consists of an abrupt initial rise, a slower secondary rise and a decay toward the steady-state, as was previously shown by Franck and Wood.[1] The simultaneously observed rate of CO_2-uptake follows a course inversely related to fluorescence. In low O_2 (Fig. 1) these curves are almost exact mirror images as to time. In normal air (Fig. 2) the decay in fluorescence is more rapid, but the induction in CO_2-uptake is prolonged. For comparison the low O_2 curves of Fig. 1 have been superimposed as broken lines (- - -). Apparently the induction in normal air is caused by two processes, one of which involves an inverse, the other a direct relation between rate of CO_2-uptake and intensity of fluorescence. Assuming arbitrarily that the second process does not occur at all in low O_2, its magnitude in normal air is indicated by the hatched areas. The dependence of the direct relationship on O_2 and the *observation of a greater* rate of CO_2-uptake in low O_2 suggests that this process involves a photoxidation.

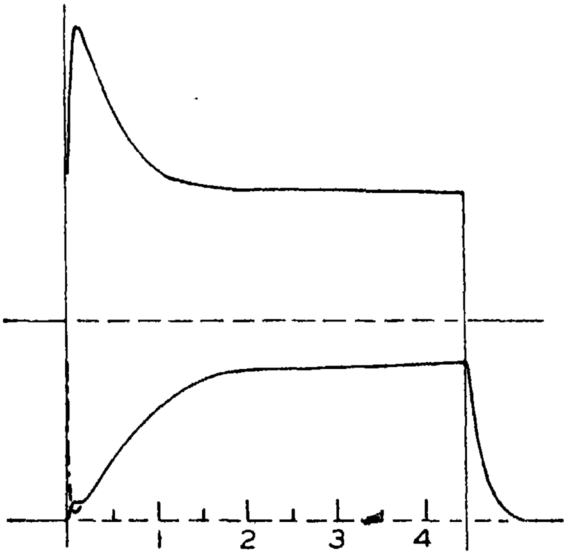

Fig. 1. Induction behavior of wheat in .03 per cent. CO_2 in N_2. (Ordinates: rate of CO_2-uptake [lower] and intensity of fluorescence [upper] in relative units; abscissas: time of illumination in minutes).

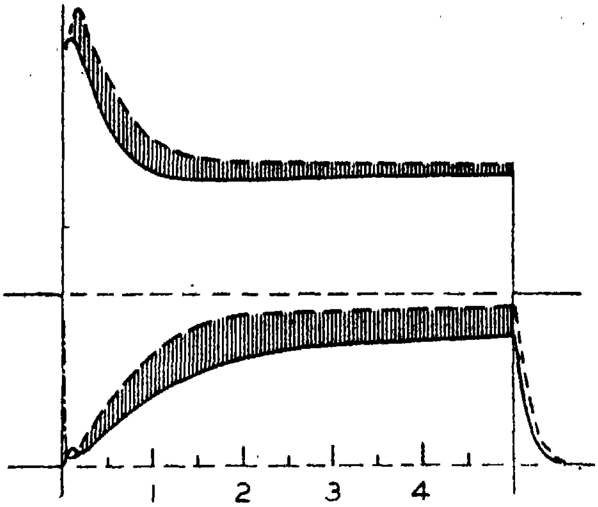

Fig. 2. Induction behavior of wheat in air (solid lines). Curves of Fig. 1 are superimposed as broken lines.

Under CO_2 concentrations greater than that of normal air the induction in wheat (Fig. 3) is complicated by a second maximum in fluorescence. The simultaneous minimum in rate of CO_2-uptake is clearly inversely related. The broken lines, here arbitrarily drawn in, merely show the possible course in the absence of the second process.

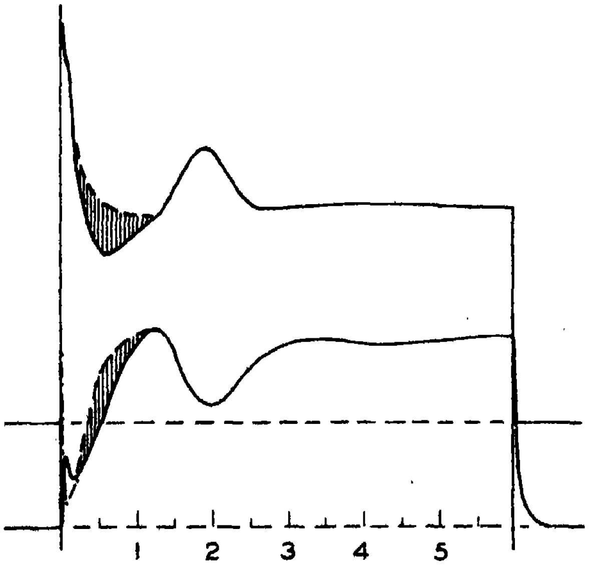

Fig. 3. Induction behavior of wheat in .24 per cent. CO_2 (solid lines). Ordinates for rate of CO_2-uptake $\frac{1}{2}$ scale of Figs. 1 and 2. Hatched areas represent the minimum extent of a direct fluorescence-CO_2 relation.

In *Chlorella pyrenoidosa* the induction behavior is greatly influenced by the previous conditions of culture. Cells grown in 4 per cent. CO_2 show a behavior quite comparable to that of wheat. In the induction shown by cells acclimated to .03 per cent. CO_2 the photoxidation type of reaction predominates to such an extent that minima are produced in both the fluorescence and CO_2-uptake curves (Fig. 4). The arbitrarily drawn broken lines enclose hatched areas representing (as in Fig. 3) what may be considered the minimum extent of the second type of reaction.

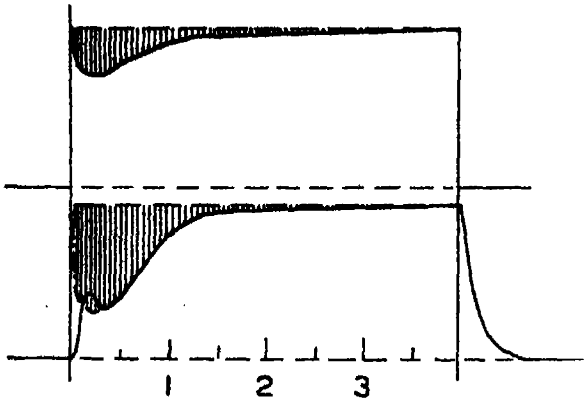

Fig. 4. Induction behavior of *Chlorella* cultured in air. The upper boundaries (broken lines) of the hatched areas are arbitrarily drawn.

The behavior observed in several hundred induction curves, obtained over a wide range of conditions, may be described in terms of two processes. One of these involves an inverse relation between rate of CO_2-uptake and intensity of fluorescence, the other a direct relation. Further and more quantitative work is being undertaken in order to learn more of the nature of these two processes.

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ETHYLENE INJURY TO CUT FLOWERS IN COLD STORAGE ROOMS

It has been known for some time that even traces of illuminating gas leaking into a greenhouse are detrimental to flowers and plants.[1,2] Little consideration has been given, however, to the possible presence of gases toxic to cut flowers where they are kept in refrigerators to prolong their period of salability.

Investigations have recently been started at the United States Horticultural Station, Beltsville, Maryland, into the problem of increasing the keeping quality of cut flowers. The flowers so far included in these investigations are carnations, roses, snapdragons, stocks and narcissus. They were all, with the exception of the narcissus, grown in the Department greenhouses at Beltsville. The latter were grown in outdoor beds. Ample supplies were available in all instances.

Among the factors studied, that of temperature was given considerable attention in an attempt to find optimum conditions when refrigeration alone was considered.

Early in the course of these experiments it was found that ethylene, which is known to be given off by apples and other ripening fruit,[3,4,5] caused identical injury to cut flowers when they were placed either in sealed containers with ethylene or in storage room with apples or even in rooms close by.

Check lots of flowers at 70°, 50° and 36° F. remained in good condition longer than corresponding lots stored in the presence of fruit or ethylene at the same temperature, and with fruit or ethylene, the higher the temperature, the more pronounced was the effect of the gas.

Carnations, roses, snapdragons, narcissus and stocks under these conditions were all adversely affected. The damage to carnations in full bloom was indicated by an incurving of the edges of the petals and they also became discolored and lost their turgor. This effect was typical of the deterioration of carnations commonly known to flower growers as "sleepiness," which may occur both before and after the flowers are cut, and is believed to result from unfavorable environmental conditions. The symptoms of injury observed on cut roses and snapdragons consisted of a discoloration and early dropping of the petals and flowers. Narcissus and stocks reacted by a deterioration of color and shriveling of the flowers.

In general, florists are of the opinion that carnations keep best at a temperature close to 50° F. However, Neff[6] and the writers have found temperatures between 33° and 36° to be best. The accepted opinion in favor of 50°, rather than the lower temperatures, may have been arrived at as a result of frequent damage to carnations stored in room with ripening apples. Most large cold storage buildings have large quantities of ripening fruit in storage rooms where cut carnations would be stored by florists anticipating peak demands just prior to holidays. Neff reported that his best results were obtained in sealed containers, while the writers used rooms free from the influence of ethylene. Hence in both of these cases the flowers were not damaged by this gas. Most fruits are not generally stored at 50° F. and therefore carnations stored at this temperature would not be so apt to be injured by gases from apples or other fruits. It appears that a temperature of 34° to 36° is best for carnations if they are kept in a room free from ethylene.

---

[4] National research fellow.

[1] W. Crocker, *Flor. Exc.*, 70: 15 and 54, March 30, 1929.

[2] P. W. Zimmerman, W. Crocker and A. E. Hitchcock, *Proc. Amer. Soc. Hort. Sci.*, 27: 53–56, 1931.

[3] R. Gane, *Great Britain Dept. Sci. and Ind. Res. Food Invest. Bd.*, 1934: 122–123, 1935.

[4] E. Hansen and H. Hartman, *Plant Physiol.*, 12: 441–454, 1936.

[5] J. A. Milbrath, E. Hansen and H. Hartman, Science, 91: 100, 1940.

[6] M. S. Neff, *Plant Physiol.*, 14: 271–284, 1939.

In the light of these findings it seems desirable that results of flower storage investigations which might have been influenced by the gases from ripening fruit should be repeated. It is also suggested that the effect of ethylene, whatever its source, on plants and plant parts other than cut flowers should be fully investigated as a factor in storage problems.

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THE RELATION OF INTERNAL SURFACE TO INTERCELLULAR SPACE IN FOLIAGE LEAVES

THE relation of the exposed cellular area of the mesophyll of the foliage leaf to the volume of intercellular space has been of considerable interest because the relation has an important bearing on transpiration rate and on other types of gas exchange. Although the volume of intercellular space was measured by Unger as early as 1854 and has been measured by several investigators since, the relation of internal surface to volume of intercellular space has been largely a matter of conjecture.

In a sample of twenty leaves from four alfalfa plants, the coefficient of correlation (r) between the internal-external surface ratio and the volume of intercellular space per sample area, as shown in Table 1, was + 0.874; and between the internal-external surface ratio and the percentage volume of intercellular space, the coefficient of correlation was + 0.629. Although the correlation coefficient is higher between the internal-external surface ratio and volume of intercellular space than between the internal-external surface ratio and percentage volume of intercellular space, for both values the probability of chance occurrence (P) is less than 0.01, and the correlation coefficients are highly significant. The relation of the internal-external surface ratio to other mesophyll factors is expressed by the equation

$$R = \frac{t\,v\,(1-v)\,K}{d}$$

where R = the internal-external surface ratio, t = leaf thickness, v = percentage volume of intercelluar space, d = cell diameter, and K = a constant.

TABLE 1

THE COEFFICIENT OF CORRELATION (r), AND ITS LEVEL OF SIGNIFICANCE (P) BETWEEN INTERNAL-EXTERNAL SURFACE RATIO AND VOLUME OF INTERCELLULAR SPACE AND BETWEEN INTERNAL-EXTERNAL SURFACE RATIO AND PERCENTAGE VOLUME OF INTERCELLULAR SPACE OF FOLIAGE LEAVES

Leaf samples	Intercellular space	r	P
Alfalfa	Volume	+ 0.874	< 0.01
Alfalfa	Percentage volume	+ 0.629	< 0.01
16 species	Volume	+ 0.463	< 0.10
16 species	Percentage volume	+ 0.071	> 0.10

Random samples of leaves of sixteen different angiosperm species from various parts of the world showed no significant correlation (+ 0.071) between the internal-external surface ratio and the percentage volume of intercellular space, but showed a moderate positive correlation (+ 0.463) between the internal-external surface ratio and the volume of intercellular space (Table 1). For the latter value, P lies between 0.10 and 0.05 (Table 1); thus the correlation coefficient is not significant.

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THE ENZYMATIC DEACETYLATION OF HEROIN AND CLOSELY RELATED MORPHINE DERIVATIVES BY BLOOD SERUM

IN preliminary experiments designed to study the effect of morphine on choline esterase activity it was found that morphine salts were precipitated as the alkaloidal base in bicarbonate Ringer solution. An attempt was made to obviate this difficulty by using the more soluble and physiologically more active diacetylmorphine (heroin).[1] An apparent stimulation of the activity of choline esterase led to the measurement of the effect of serum on heroin. It was found that rabbit and human blood sera deacetylate diacetylmorphine.

The measurements of the rates of deacetylation were made with Barcroft manometers at 37.5° C. under an atmosphere of 95 per cent. oxygen and 5 per cent. carbon dioxide. The serum was tipped from a side arm of the manometric flask into a bicarbonate-containing solution of the acetylated morphine, and the carbon dioxide liberated was measured manometrically at desired intervals.

Observations were made using sera from six male albino rabbits, all fed Purina rabbit chow and lettuce. Sera (0.05–0.5 cc) from three of the animals, when added to diacetylmorphine (5.0 mgm), caused a rapid liberation of carbon dioxide corresponding in quantity to 85 per cent. of the theoretical for the hydrolysis of both acetyl groups. The other three animals hydrolyzed the heroin more slowly and liberated carbon dioxide corresponding to 85 per cent. of the theoretical for one acetyl group. Repeated observations over a period of two months always gave identical results for each rabbit.

---

[1] I am indebted to Dr. L. F. Small, of the National Institute of Health, for furnishing the morphine derivatives and for consultation on their chemistry.

By substituting monoacetylmorphine for the diacetylmorphine it was found that the animals that were able to remove both acetyls from heroin were able to hydrolyze the 6-carbon acetyl in monoacetylmorphine. Sera from the other three rabbits did not liberate acetic acid from the monoacetyl compound. Therefore, all the rabbits were able to remove the 3-carbon acetyl group, but the sera of only three of the animals hydrolyzed both acetyl groups present in diacetylmorphine.

Further work using diacetyldihydromorphine as the substrate showed that all six rabbits were able to remove acetic acid from this compound, equivalent to approximately 100 per cent. of the theoretical for one acetyl group. Again, however, there was a distinct separation of the rabbits into two groups of three animals on the basis of the rate at which hydrolysis took place. The sera from the three rabbits that were unable to deacetylate monoacetylmorphine hydrolyzed the dihydrodiacetylmorphine at a much slower rate.

At this point it was predicted that the diacetyldihydromorphine was hydrolyzed at the 3-carbon, and subsequent determinations with monoacetyldihydromorphine as substrate proved this to be true, since none of the animals were able to deacetylate this compound.

Preliminary experiments have shown that human blood serum is able to deacetylate heroin, but at a distinctly slower rate than any of the sera from the rabbits so far investigated.

Physostigmine inhibits the activity of the enzyme responsible for the deacetylation of the acetylated morphine derivatives. This indicates the possibility that the enzyme might be choline esterase. However, all six rabbit sera have almost identical capacity for hydrolyzing acetylcholine. Also, the human sera so far investigated have much higher concentration of choline esterase than the rabbit sera and at the same time a lesser capacity for the hydrolysis of heroin.

From these results it seems probable that, in the rabbit at least, the difference in potency of heroin and morphine might be fundamentally due to physical factors such as solubility rather than chemical structure, since it appears likely that the animal, in the final analysis, is reacting to morphine, whichever of the two alkaloids is injected. The same applies to monoacetylmorphine.

It would be of considerable interest to determine whether the esterase attacking the acetylated morphines is present in the tissues, especially the central nervous system and to extend the investigation to include other species of animals. It is also possible that certain other morphine derivatives, after entering the body, are converted into morphine. If so, this would be of considerable aid in clarifying some of the similarities and differences in physiological activity that have been found among the chemical compounds related to morphine. The investigation of these possibilities and others not so obvious is now planned.

This is a preliminary report and will be published in detail elsewhere.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A TECHNIQUE FOR THE INTRAVENOUS INOCULATION OF CHICK EMBRYOS

IN the course of experimentation on the growth of various viruses in chick embryos, the need of a simple technique for the inoculation of embryos directly into the blood stream became very evident.

The method of Goodpasture, *et al.*,[1] consisting in removal of that portion of the shell over a vein or the air sac, application of mineral oil to the membrane to render it transparent and then picking up the veins for injection and subsequent searing of these veins, was tried. While some success by this method may be noted, it has several disadvantages, notably difficulty encountered in injection due to the mobility of the vein during inoculation.

Secondly, there was considerable hemorrhage on withdrawal of the needle even after cauterization of the vein at two points before withdrawing the needle.

A third difficulty is that the removal of the shell cap over the air sac exposes a large area and subsequent maintenance of sterile conditions is difficult even after sealing with Scotch tape.

Accordingly, the following procedure was developed at the laboratories of the Pathological Division of the Bureau of Animal Industry.

Ten- to eleven-day-old embryos were found to be the youngest which could be easily injected routinely. The eggs are candled to locate a vein of the terminal sinus which is fairly straight and which lies embedded in the chorio-allantoic membrane.

This section of vein is then marked on the shell for about 1–1.5 cm, and an arrow indicating direction of blood flow is marked nearby.

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[1] Polk, Buddingh and Goodpasture, *Am. Jour. Path.*, 14: 1, January, 1938.

Injection of the material in the direction of the blood flow is important, as hemorrhage usually results if the needle is inserted against the flow.

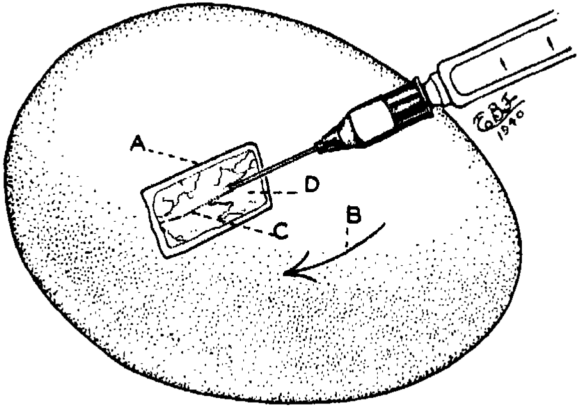

FIG. 1. A. Section of shell removed leaving shell membranes intact. B. Arrow showing direction of blood flow. C. Vein. D. Shell membranes made transparent by oil and adhering chorio-allantoic membrane.

A square of approximately 1 cm is then cut through the shell to the inner shell membrane around the portion of the vein marked on the shell. This is done by means of a high-speed grinder such as the Handee or Moto-tool. If the grinder is clamped to a stand and the egg manipulated, the cutting of the shell is facilitated as more accurate pressure may be applied. Care must be taken not to cut through the outer and inner shell membranes, as the chorio-allantoic membrane will then usually pull away from the outer shell membranes and it will be impossible to expose the vein. The cut section of shell is then lifted away by inserting any fine-pointed instrument in the cut and lifting.

A drop of light, sterile mineral oil is then placed on the membrane, which immediately becomes transparent, exposing the vein, and the egg is ready for injection.

It is advisable to use a ¼ cc tuberculin syringe with a 25-27 gauge needle, and the angle of insertion should be as acute as possible using the posterior edge of the cut as a support, while the bevel of the needle is held uppermost. Withdrawal should be extremely slow and caution exercised to prevent possibility of hemorrhage. In this connection it was found that the probability of hemorrhage with veins larger than the diameter of the needle is greater than with those slightly smaller, hence it is preferable to pick out, if possible, a portion of a vein of medium size.

After the needle is withdrawn, the egg is sealed with a 6 per cent. solution of paralodion in ether.

In bleeding the embryo, the same procedure is followed, with the exception that the needle is inserted against the direction of flow. Quarter cc amounts have been bled from embryos without apparent damage and quantities of blood up to 0.1 cc injected with survival. Allantoic fluid, however, has proved fatal in a few minutes when injected intravenously in 0.01 cc quantities, producing tremendous hemorrhage in the embryo proper.

In conclusion, there have been 32 passages to date from egg to egg in series by this method, while mortality rate due to hemorrhage in faulty manipulation has been approximately 30 per cent., but there is no reason why this can not be considerably reduced with improved technique.

ERVIN A. EICHHORN

U. S. DEPARTMENT OF AGRICULTURE

MOUNTING EMBRYOLOGICAL MUSEUM SPECIMENS WITH GLASS WOOL

By using the following technique a practically transparent, as well as artistic, suspension of specimens may be obtained.

First, pour mounting medium in jar (10 per cent. formalin, or glycerin, etc.). Second, place specimen in jar of medium and encircle it with the least possible amount of loosely meshed, fine, glass wool, enough to hold the object suspended and freely oriented to present the most satisfactory picture.

ETHEL W. VENNING

UNIVERSITY OF VIRGINIA

BOOKS RECEIVED

ADDICKS, LAWRENCE, Editor. *Silver in Industry.* Pp. vii + 636. Illustrated. Reinhold. $10.00.

CLAUSEN, JENS, DAVID D. KECK and WILLIAM M. HIESEY. *Experimental Studies on the Nature of Species: I, Effect of Varied Environments on Western North American Plants.* Pp. vi + 452. 155 figures. Carnegie Institution of Washington. $3.50.

DE HAAS, J. H. and IR. O. MEULEMANS. *Melk in Het Bijzonder Als Zuigelingenvoedsel.* Pp. 104. Drukkerij Smits, Batavia.

DE VRIES, LOUIS. *French-English Science Dictionary; For Students in Agricultural, Biological and Physical Sciences.* Pp. viii + 546. McGraw-Hill. $3.50.

HOGBEN, LANCELOT. *Principles of Animal Biology.* Pp. 415. 147 figures. Norton. $3.75.

MARK, H. and G. S. WHITBY, Editors. *Collected Papers of Wallace H. Carothers on Polymerization.* Pp. xix + 459. Illustrated. Interscience Publishers, New York. $8.50.

NEEDHAM, JAMES G. *Introducing Insects; For Beginners.* Pp. v + 129. Illustrated. The Jaques Cattell Press, Lancaster, Pa. $1.50.

NETTLETON, L. L. *Geophysical Prospecting for Oil.* Pp. xi + 444. 177 figures. McGraw-Hill. $5.00.

OSBORN, FREDERICK. *Preface to Eugenics.* Pp. xi + 312. Harper. $2.75.

RICHARDSON, E. G. *Sound.* Pp. vii + 339. 118 figures. Longmans, Green. $5.25.

WHITBECK, R. H., FRANK E. WILLIAMS and WILLIAM F. CHRISTIANS. *Economic Geography of South America.* Third edition. Pp. xi + 469. 203 figures. McGraw-Hill. $3.50.

WINDLE, WILLIAM F. *Physiology of the Fetus; Origin and Extent of Function in Prenatal Life.* Pp. xiii + 249. 70 figures. Saunders. $4.50.

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BIOLOGICAL RESEARCH AFTER A CENTURY OF DENTISTRY[1]

By Dr. THEODOR ROSEBURY

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PHYSICIANS who do not practice medicine, but devote all their working time to research and teaching in a field of medical science, are numerous enough nowadays to be taken for granted. Dentists in parallel circumstances, however, are still extraordinary. Research on problems of disease of the mouth and teeth is still a neglected field; and in view of the prevalence of such disease and its great economic importance our ignorance of it is even more extraordinary. This year marks the centennial of the establishment of the first dental school and the first dental journal, which signalized the emergence of dentistry as a profession. After one hundred years the dental profession points with justified pride to its many noteworthy contributions to human welfare and comfort, but these achievements do not include very much positive advancement in knowledge of the diseases which determine dentistry's existence. Physicians and dentists generally appreciate this fact, and many feel capable of offering an explanation of it, often to the discredit of dentistry. Since I am one of the rare birds alluded to—a dentist who devotes all his time to research and teaching—my opinion on this subject may be of interest. For 12 years, working in the environment of a large medical school which is an active center of medical research, I have given all my research time to problems of dental disease. During much of this period I have taught one of the basic sciences and its dental applications to the students of the associated dental school and aided in the teaching of medical and graduate students. From the beginning I have been keenly interested in the comparisons which these circumstances have continually presented to me, of the medical with the dental—students, faculties, research workers, facilities, and what may be called the respective intellectual and scientific climates. These comparisons form the basis of what follows.

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[1] Prepared by invitation of the American Dental Association's Committee for the Dental Centenary Celebration, 1940.

At the outset, curiously, it seems necessary to argue that the problems of dental research are important. The importance of research is estimated variously in various circumstances. Most research workers, as I know them, are guided in their choice of problems (when they are free to choose) primarily by the sort of feeling that prompts them to read the detective stories of a particular author, or to seek the image of a particular movie queen: it is a matter of what they like, or of what others like. Of course their choice is influenced by their knowledge and skill, and by the assistance and physical equipment at their command. It is likely to be modified by the funds available, whether because some problems are inherently more or less expensive or because money on hand is earmarked for some special purpose. Sometimes a problem is chosen directly because of its public importance or because it deals with or is likely to illuminate a broad and fundamental principle; and sometimes one is chosen because it seems certain to yield a publication with little effort and in a short time. But primarily the problem is selected because it quickens the research worker's curiosity and interest; he likes it, and this is as it should be. Now it happens that I like dental problems. If others fail to admire my taste, I can sometimes return the compliment.

The importance of research problems is probably more objectively evaluated by those outside research or at all events from their collective point of view. Here problems become important in proportion as they deal with fundamental principles or directly or indirectly influence human welfare. Dental problems have not seemed important with respect to fundamentals. The problem of dental caries, for example, is in several respects unique. Knowledge of other diseases has been of little aid in solving it, and its own solution is unlikely to throw much light on disease elsewhere. But if this is true of dental caries, it is less true of other dental problems. For example, the work of Schour and his collaborators on the growth and development of the teeth is not only rapidly increasing knowledge of that limited field, but is likewise aiding in the development of methods of wide applicability and in the formulation of laws governing the whole process of growth and development. Again, exploration of the bacterial flora of the mouth, on which, despite sporadic researches over many years, only a bare beginning has as yet been made, will not only clarify many questions of disease of the mouth, but seems likely also to help explain the origin and character of certain extra-oral diseases (such as the "fuso-spirochetal" group). What may be more fundamental, the collateral study of mouth infection of low virulence may also be expected to provide a fruitful approach to the whole question of natural resistance.

As for their influence on human welfare in general, there can be little valid question of the importance of dental problems. Poliomyelitis is more dramatic than pyorrhea; one seems terrible, the other commonplace. Yet I think a man from Mars, apprised of all the facts of distribution, of mass damage and of ultimate effects, would have no hesitation in choosing pyorrhea as the more important. And dental caries, by the same standard, is more important than pyorrhea. In recent years there has indeed been an awakening appreciation of dental problems in medical circles. Perhaps recent dental research is having a stimulating effect, and possibly also the realization is growing that dental problems can be as "likable" as any others. Nevertheless, the public importance of problems of dental disease has been very inadequately appreciated; and as one consequenc only a disproportionately small share of the funds allocated to research on disease in general has gone to support dental problems.

Although I admit that dental research is still a neglected field, it is not as though it were completely unexplored. Even in the 1880's, when medical research received the impetus that eventuated in its modern phase, W. D. Miller and G. V. Black, both dental practitioners, published researches on fundamental dental problems whose influence is as strongly felt to-day as that of many medical classics of the same period. And since that time there have always been a few workers, here and abroad, some of whose contributions have solid and durable value. It may be significant that some of the best among them, as witness I. J. Kligler and A. T. Henrici, went on to greener pastures, presumably because the opportunities in the field of dental research in their time were not attractive enough to hold them.

That was about twenty-five years ago, and it may be said that the first three quarters of the period now being celebrated by dentistry saw individual dental researches of merit, but no organized or wide-spread research activity. Since that time there has been an appreciable expansion, due in part to improving predental education, in part to the frank statement of deficiency embodied in the Carnegie Foundation's Bulletin No. 19, prepared by W. J. Gies and published in 1926, and no doubt in part to accumulating awareness within dental educational circles themselves that sound scholarship, in dentistry as elsewhere, can not exist without the spirit of research. To Gies, in addition, goes the credit for establishing the *Journal of Dental Research* in 1919, and the International Association for Dental Research in 1920. The latter, now affiliated with the American Association for the Advancement of Science, has acquired about 500 members, conducts regular sectional meetings in many parts of this country and abroad and a two-day annual meeting of which no scientist need feel ashamed. And the *Journal of Dental Research,* now owned and controlled by the I.A.D.R., can hold up its head in the best medical company, and is finally approaching actual financial stability!

In more recent years additional stimulation of research on dental problems has come in the form of grants in support of research or dental graduate teaching or both, from such agencies as the Rockefeller Foundation, the Commonwealth Fund and the Carnegie Corporation. The last named is currently pursuing the far-sighted policy, of establishing dental graduate fellowships leading to research and teaching positions on dental faculties, which is certain to have salutary effects. To-day most large dental schools and some small ones have a research program of some kind; the Public Health Service is sponsoring fundamental research on dental problems; and the fellowships for graduate training of dentists now being offered at several centers—thanks largely to the Carnegie Corporation—are coming to be eagerly sought after.

Things are looking up. Yet the field is still not what it should be. It remains true that in most dental schools research, however much the word may sometimes be glorified, proceeds under severe handicaps or not at all. Opportunities for recent dental graduates leading toward careers in research and teaching in dental schools have only begun to appear, and there is still no satisfactory basis upon which young men of promise and outstanding ability might be encouraged to prepare themselves for a life work independent of dental practice. It is still true that there is not enough incisive dental research going on to do more than scratch the surface of the major problems of dental disease. In these respects dental research differs conspicuously from medical research, and it is my purpose to inquire into them more particularly.

The major dental problems are not simple ones. From the little we know of dental caries and pyorrhea and of the various common forms of gingivitis and stomatitis, for example, it is clear that none is a simple infection, a simple dietary deficiency disease, the result of any simple or single cause. It is becoming plain that their effective solution will not be achieved without full recognition of the peculiar characteristics of the teeth and their surrounding structures, that is, without the knowledge which is part of the dentist's special training. There is plenty of room in the field of dental research for physicians and for those whose primary training is in one of the basic sciences; but the development of broad concepts, the true interpretation of groups of data, the synthesis of isolated researches, calls for the special knowledge of the dentist. Dentists, in other words, or those whose primary training is in dentistry, ought to lead the field of dental research. Their special knowledge, moreover, is better calculated than the lack of it to stimulate a genuine interest in dental problems, to motivate the drive without which research never amounts to much.

The dental student to-day shows abundant promise of aptitude and capacity for research, comparing very favorably with the medical student. The great majority in both groups, of course, could not and should not be diverted from practice. But only occasional and exceptional medical students go on to careers in research. Similar occasional and exceptional dental students appear in full measure, particularly in response to the stimulus of increasing awareness of the problems awaiting solution in their field. Dental students have changed appreciably in this respect even in my own comparatively short period of experience with them. Improving pre-professional education has doubtlessly contributed toward keener appreciation of dental problems; increasing research activity itself has had an autocatalytic effect: a little has induced more. And, of course, changing economic conditions have done their share. The future in practice does not seem quite so rosy to the student to-day as it did fifteen years ago. He is much more ready to accept unpaid or poorly paid interneships to improve his clinical training, or the graduate fellowships which are becoming available, to prepare for clinical teaching or research. But opportunities for such graduate training are still far too limited; and more distant prospects—opportunities on dental faculties, for lifetime careers in research and teaching positions—are still so meager that most of the qualified students prefer the lesser insecurity of practice. The seeds of a healthy dental research plant, in short, are ready to germinate; but the soil is not yet ready to receive them.

The soil is the dental school, and its infertility is its own retarded scientific development. I think this fact will not be seriously disputed; but I also think that the blame for it does not rest solely on the dental schools themselves. Medical schools must shoulder a full measure of it. Two interrelated circumstances seem to me to be responsible for the slow scientific development of dental schools. The first is that instruction of dental students in the basic science subjects is given, as a rule, by associated medical schools, which often overlook the dental applications of these subjects; the second is that clinicians, by and large, are not research-minded.

We should expect research activity to be stimulated by example in dental schools that are closely associated with medical schools in which research is active. Yet most of the research in such medical schools is done in the basic science departments; these departments include among their functions the instruction of dental students; yet they usually overlook dentistry in their research programs. There are, of course, subsidiary circumstances which underlie this one. Lack of adequate understanding of research or of interest in it on the part of dental faculties may be one of them, and if so, is linked to the second major circumstance to be considered later. More pertinent seems the fact that instruction of dental students in the basic sciences does not usually have, and is not expected to have, a dental orientation. Commonly the course for dental students is an abridgment of that for medical students. The instructor in charge, as a result of his own training or by example from his department at large, has a medical orientation, and sees no need or perhaps no opportunity to adapt his course to the special requirements of dental students. This is likely to be exactly what the dental faculty itself requests or at least sanctions. I need not raise the question whether this practice is good or bad in its general effects, but that it militates against a healthy development of dental research can hardly be questioned. Research and teaching are both at their best when each interacts with and stimulates the other. The conscientious teacher utilizes past and current research to breathe life into his courses, and in so doing attains the most favorable position to discover the gaps and uncertainties in his subject that call for investigation. The teacher of a basic science subject who ignores its ramifications into the dentist's special field is unlikely to become aware of the problems that exist there, still less to be stimulated to explore them.

It is not my intention to argue that, for any reason, instruction of dental students in the basic sciences should be completely separated from that of medical students, or even that the dental courses should be altered in any radical way. It seems to me self-evident that instruction in general principles should be the same for both groups. But all courses include application of the principles, and it is here that substitutions might be made. Material of special interest to the physician can be displaced by subject-matter better suited to the needs of the dentist. In biological chemistry, for example, a little less time might be devoted to urine and milk, a little more to saliva; a little less to muscle and other tissues as such, a little more to the special problems of the composition and calcification of bone and teeth. The biochemist may find little on these substitute topics in text-books, precisely for the reason that they are generally given no more than a passing glance in the medical courses for which the books are written. If he takes the trouble to dig for it, however, he will find enough to vitalize his whole course for dental students. At the same time he may discover that there are fascinating research problems dealing with the mouth and teeth which lie wholly within his own proper field. From my own experience I know, moreover, that dental students, who may sometimes evince a certain detachment, even verging on apathy, toward a subject whose bearing on their own field is imperceptible, come to life when they see the application plain. Not only does their own curiosity and interest stimulate investigation by their teacher; the students themselves willingly grasp any opportunity to participate in such investigation. If more basic science courses were presented to dental students with the sort of dental orientation here suggested, and the spirit of research conveyed to them not as something beyond their reach, but as an atmosphere surrounding the answers to their own questions, some among the students would ultimately help to contribute answers to those questions. Meanwhile, more dental research would be done in medical schools.

I submit, furthermore, that these suggested alterations looking toward a more dental orientation of basic science courses ought to be initiated by the instructor in charge of dental students, without waiting for the suggestion to come from superiors or dental faculties. The instructor should strive to do the best job he can, and this is a means toward that end. On the other hand, it would probably do no harm if dental faculties went at least as far as to encourage him by seeming interested.

This brings us to the second major circumstance which in my view has held back the growth of research in dental schools: the lack of due appreciation of research among dental faculties. This is a matter of great importance; yet rather than join the chorus of the supercilious whose confidential remarks imply an inherent and unalterable defect of the dental mind, I propose, being a dentist myself, to condone it by explaining it. We may, indeed, dismiss the clinician as such, with a few outstanding exceptions, as all but hopeless in this regard. But be it noted well! as I know him the dental practitioner, by and large, is no worse than his medical brother under the skin, except as the accumulated pressure of accomplished medical research has forced the physician to recognize its value. May I recall that Sydenham, peerless among clinicians of his time, is now charged in certain quarters with having delayed the development of epidemiology by nearly two centuries, and that Pasteur had certain difficulties with physicians? For the most part the dental clinician is a hard-headed practical fellow by necessity. The patient is his problem; research is of value to him only in its final stage. He can not afford the detachment that research demands before that final stage is reached, and we who do research can not expect him to support us until we have proved our worth in terms of practical usefulness to him. In short, dental research must get its support from other sources first, and hope that clinicians will ultimately come over, as physicians have done increasingly, when they see their own advantage in doing so.

Nevertheless, whereas medical schools maintain their research-conscious basic science departments as the backbone of their scientific framework, the associated dental schools, sharing the same basic science departments, are thereby largely deprived of backbone: for the remaining members of dental faculties are nearly all clinicians. There is, on the other hand, a smaller group of dental faculty members who are not clinicians or whose position on the faculty, at all events, is not clinical. These include the teachers of applied phases of those basic science subjects in which special dental requirements are generally recognized—anatomy, histology and pathology. It may be said that these teachers should shoulder the greatest measure of responsibility for research in dental schools. Many of them do so, and some of them do so very effectively: the group includes some of the foremost dental investigators. Others, unfortunately, either give no indication of research activity at all or, what may be worse, attempt investigative work, and even publish voluminously, while giving every evidence of an utter lack of appreciation of the meaning of research. This type of teacher has of course not become extinct as yet even in medical schools, and is well known in medical as well as in general scientific history. The name of Pouchet occurs to me as a conspicuous example. In dental schools I have been told that they are still numerous. Some of them are said to have an inhibitory effect on research in their environments analogous to the effects of the theories they promulgate. These latter, being deductive and plausible, lacking either experimental background or any feasible avenue of verification, presented with scholastic authority, still—seventy years after Claude Bernard!—satisfy the student's curiosity instead of stimulating it, or provoke only feeble and futile attempts "to prove" their theories. And I am told that investigations which tend the other way are still fraught in some quarters with unpleasant consequences for the investigator. The true spirit of research has never prospered in such an atmosphere.

Nor do I see any immediate prospect of a cure for this particular manifestation of the chronic deficiency disease which currently afflicts dental research. Medical research was in a somewhat similar position sixty years ago, before the experimental method achieved its present respectability; but there is a double-barrelled difference. Medical research *has* gone on, during the interval, and become virtually a profession or group of professions in its own right. Dental research now has both a living example for emulation which medicine lacked during its own adolescence and a grown-up cousin who usurps the spotlight and covers his smaller relative with a magnificent shadow. Medical schools have assumed part of the responsibility for training dental students. I think the real cure of dwarfism in dental research is likely to come only as the research departments of medical schools take that responsibility more seriously. Time will eliminate the unscientific and pseudo-scientific teachers of science in dental schools only in proportion as younger men with better basic training emerge to take their places and as additional places are created for them to take. Medical schools must carry a large part of the burden of training those younger men. At the same time, the subject will grow if they undertake their own share of research on dental problems, and a better research environment will thereby arise by direct example in the associated dental schools.

The field of dental research to-day shows some of the awkward features of retarded development which will disappear of themselves, I think, as maturity approaches. There is too much spirit and not enough substance in our literature. There is a great deal of foolish competition and not enough cooperation among research workers. Among investigators of dental caries, for instance, each one, apparently hoping to achieve fame as the sole discoverer of the cause, blows his own horn lustily and airily ignores his neighbor. The total effect is a glorious cacophony. Again, not only is self-criticism poorly developed in general, but the ability to give and take criticism in true cooperative spirit is often altogether lacking. But these are merely symptoms of the condition described. We need more healthy young blood, a greater infusion of the sort of interest in dental problems, based on adequate training, which will be deep and sound enough to transcend the legitimate interest of the individual in his own material advancement. One approach to that goal should be to make material advancement less precarious.

From the inside, then, one hundred years of dental research in retrospect provide little basis for self-congratulation. Dental research is still the weakest link in the chain of dental achievements to be celebrated this year. During the same period medical research, building upon developments in chemistry and biology in the decades before 1840, emerged as a group of organized activities in the 1880's and later, and has since achieved adult stature. Dental research has lagged behind, entering upon an analogous phase of organized expansion only in recent years, so that at the moment it presents the stigmata of a somewhat retarded adolescence. Good dental research is now being done, but not enough to crack the major problems of disease that constitute its field. These problems are complex, in that probably no single basic science will provide the answer to any of them, and peculiar, in that the development, structure, chemistry and pathology of the dental tissues are distinctive. The special training of the dentist should help to solve them. Improving predental and dental education is now producing students able and eager to work along these lines, but opportunities for them to do so are far too limited. Research activity in dental schools remains at a low level, first because dental schools usually lack research-conscious basic science departments, which are shared with medical schools and there oriented away from dentistry, secondly because clinical dental faculties and many teachers of applied dental sciences are undeveloped or poorly developed as investigators. Since medical schools, with their own well-developed research programs, largely control the basic science departments of dental schools, the medical schools ought to take their responsibility toward dentistry more seriously. By giving their courses for dental students more of a dental orientation the instructors in charge may be stimulated to explore the dental field. The dental student may then in turn find greater opportunity to help. The cumulative effect of awakening dental interest and activity in medical schools may finally open the field for further study and research by dental graduates, and thus provide both the material and the impetus for the changes in dental faculties which are most necessary for the maturation of dental research.

SCIENTIFIC EVENTS

THE NEW TELESCOPE OF THE OAK RIDGE STATION OF THE HARVARD ASTRONOMICAL OBSERVATORY

A new telescope was the center of considerable attention on September 14, when delegates of the American Astronomical Association at the sixty-fourth meeting at Wellesley College, paid a visit of inspection to the Oak Ridge Station of the Harvard Astronomical Observatory.

The telescope, shortly to be in operation, will be named the Jewett Memorial Telescope for James R. Jewett, professor of Arabic, emeritus, and his late wife, Margaret Weyerhaeuser Jewett. A substantial gift from Professor Jewett has made possible the construction of the instrument at this time.

A unique feature of this new Jewett Reflector telescope is to be found in the manner in which it is housed; the entire building revolving on a special concrete base. Usually only a top of a turret or dome rotates on tracks supported by a non-rotating building. The Jewett Reflector rotating building is twelve-sided and is insulated with homosote. Construction was under the direct supervision of Dr. George Z. Dimitroff, superintendent of the Oak Ridge Station.

The optical parts of the telescope have been completed. They consist of a 33-inch spherical mirror, and correcting plate of 24 inches diameter. This important type of telescope was invented about ten years ago by Bernard Schmidt, of Hamburg, and to date the Jewett telescope is the largest to be put into operation. Construction of larger telescopes of this type was recently started for the Boyden Station of Harvard Observatory at Bloemfontein, South Africa, and at the Palomar Observatory of the California Institute of Technology.

This new type reflector combines the advantages of the reflecting telescope and of the large-field photographic refractor. It both refracts and reflects. Ordinary reflecting telescopes cover satisfactorily only a fraction of one square degree of the sky at a time, but the new Jewett Reflector can cover from ten to a hundred square degrees, depending on the properties chosen for optical parts and mechanical parts. It is particularly effective for surveys of the distribution of galaxies and stars, variations of stars and other problems where a large coverage and high speed are essential.

The mounting for the telescope is of the two-pier type, but the special nature of the Schmidt-type reflector has made it necessary to include several unusual features. Construction is being superintended by Herbert E. Hanson of the observatory staff. Except for the polar axis and counterweights, the mounting is of Dowmetal—probably the first telescope mounting ever made of this specially light and strong magnesium alloy. The Dow Chemical Company, of Midland, Mich., cooperated in providing the difficult castings necessary for both the telescope tube and mounting.

The new Jewett Reflector is considered one of the three or four most important telescopes of the twenty-five in regular use at the Harvard Observatory, and is in some ways, because of its unusual adaptability, the most important. It will greatly extend the survey of external galaxies in the northern hemisphere and it is believed that perhaps a million galaxies will be within its range.

THE DEDICATION OF THE ADMINISTRATION BUILDING OF BELLEVUE HOSPITAL

The new administration building of Bellevue Hospital, as already reported in SCIENCE, was dedicated on September 11, with exercises, over which Dr. S. S. Goldwater, commissioner of hospitals, presided. Mayor F. H. La Guardia was the principal speaker.

Bellevue Hospital is now in its two hundred and fourth year. The new Administration Building substantially completes a long-range program dating back to 1906 when the first Pavilion of the present Bellevue Hospital was completed.

The new Bellevue Administration Building was contracted for in October, 1938, and cost about three million dollars. The Federal Public Works Administration aided in its construction, with a Federal grant of about $1,300,000. The building is connected on the north, east and south with sections of the hospital previously erected; its main façade faces west towards First Avenue. The exterior treatment of the building is of modified Georgian design, with granite to the first floor level, Harvard brick with limestone trim up to the main cornice. The following details in regard to the plan of the building have been made public:

> In the basement are maintenance shops and locker rooms for the male and female help, and a Clothing Exchange Bureau conducted by the Social Service Division.
>
> The main feature of the ground floor is a walnut panelled entrance lobby, designed to give the visitor a feeling of spacious dignity. On the right is a large public waiting room, with the Information Office, where the visitors will assemble before the visiting periods. From four to six thousand visitors will pass through this room during each visiting session. The remainder of this floor is assigned to Administrative Offices, Social Service Department and central Switchboard Room for the entire hospital.
>
> On the first floor are the Episcopal, Catholic and Jewish chapels. Each is decorated with characteristic symbols. The beautiful stained glass windows from the old Catholic Chapel, which was demolished to provide a site for this new building, were installed in the new Catholic Chapel. The remainder of this floor is given over to administrative offices.
>
> The second floor accommodates the record files and the Housekeeping Division.
>
> The third floor houses the administrative offices and classrooms of the School of Nursing.
>
> On the fourth floor are locker rooms for nurses, rest rooms and shower facilities. The remainder of this floor provides quarters for female internes.
>
> The fifth, sixth and seventh floors present quarters for male internes. Accommodations are provided in this building for approximately 250 internes.

The architects of the Administration Building were McKim, Mead and White. It was constructed for the Department of Hospitals under the direction of the Department of Public Works.

THE NATIONAL DEFENSE PROGRAM OF THE AMERICAN CHEMICAL SOCIETY

PLANS for a national defense program were announced at the Detroit meeting by the American Chemical Society. The society, with a membership of more than 25,000, is said to be the largest professional organization of its kind in the world.

A complete census of all chemists and chemical engineers in the United States, recording in detail the specialized services which they are prepared to perform, will be taken at the request of the Executive Office of the President of the United States. This is characterized as a step of major importance in the development of preparedness plans and one which will avoid the waste of trained scientific men and technicians which occurred in the World War. The casualties among scientific men in the early days of the last war deprived the Allies of vital technical services. The death of Mosley at Gallipoli, the British physical chemist, is given as an example. When the gravity of the situation was realized, the Allied military authorities hastily recalled scientific men from the trenches, but not before irreparable losses had been sustained.

Records will be compiled of the qualifications of chemists and chemical engineers so as to enable prompt and correct allocations of personnel if and when needed in event of an actual emergency. More than 70,000 questionnaires will be required to assemble the necessary data.

In accordance with its charter "the American Chemical Society shall, whenever called upon by the War or Navy Departments, investigate, examine, experiment and report upon any subject in pure or applied chemistry connected with the national defense." The society is one of the very few organizations operating under a Federal charter.

In the present situation England and Canada have listed their technical personnel in accordance with capabilities, and, while advantage can be taken of their experience, details of the roster for the United States will be a responsibility for the best thought of leaders in chemistry and chemical engineering.

The work, which will be financed by the society, will be directed by E. M. Billings, of the Eastman Kodak Company, Rochester, N. Y., and will be related to the national project to assemble a roster of scientific and specialized personnel, which is described in SCIENCE for August 16 by Dr. Leonard Carmichael, president of Tufts College, director. James G. O'Brien, defense liaison official for the Civil Service Commission, is the executive officer of the national organization. Mr. Billings is being assisted by about fifty leaders in various specialties in chemistry and chemical engineering in the initial task, now nearing completion, of devising a classification code. After it has been decided which qualifications are most fundamental, a code will be adopted, and cards containing the results of questionnaires will be sorted on electric machines of the type used in the census.

Questionnaires will be sent first to those chemists and chemical engineers who are members of the American Chemical Society, next to those now on the lists of other recognized chemical societies not members of the American Chemical Society, and finally to those not affiliated with societies representing the chemical and chemical engineering professions but who become known through suggestions made by associates.

THE BICENTENNIAL CELEBRATION OF THE UNIVERSITY OF PENNSYLVANIA

THE bicentennial celebration week of the University of Pennsylvania opened on September 16 and will close on Saturday, September 21. Details of the ceremonies have already been given in full in SCIENCE.

On the afternoon of September 20 there is planned an assembly and meeting in Convention Hall, when President Franklin D. Roosevelt, who is honorary chairman of the Bicentennial Commission, and Sir Lyman Poore Duff, chief justice of Canada, will be presented with honorary degrees. Addresses will be made by President Roosevelt, Sir Lyman, President Gates and Owen J. Roberts.

On the morning of the twenty-first there is planned a reception of delegates; addresses will be made by President Gates, Governor Arthur H. James, Provost George William McClelland, and honorary degrees will be conferred. The names of the scientific men who are among those on whom degrees are to be conferred were given in the last issue of SCIENCE.

On Wednesday former President Herbert Hoover gave one of the conference addresses. Owing to the international situation, Europeans who were expected to deliver addresses were unable to be present. These included Sir Thomas Lewis and Sir Henry Dale in medicine; Sir William H. Beveridge, economist, master of University College, Oxford; Dr. Alan J. B. Wace, professor of classical archeology at the University of Cambridge; from France, Professor Etienne Gilson, historian; Dr. Charles Cestre, professor of American literature and civilization, University of Paris, and Dr. Jacques Maritain, professor of philosophy at the Catholic Institute, Paris; from Denmark, Dr. Thorvald Madsen, of the State Serum Institute at Copenhagen; from Germany, Dr. Werner C. Heisenberg, professor of physics at the University of Leipzig; from Switzerland, Dr. William E. Rappard, political science.

RECENT DEATHS AND MEMORIALS

DR. FRANCIS HOBART HERRICK, professor of biology emeritus of Western Reserve University, died on September 11. He was eighty-one years old.

DR. GEORGE W. JACOBY, consulting neurologist of New York City, died on September 11 at the age of eighty-four years.

DR. BRUCE C. FREEMAN, of the department of geology of the Ohio State University, died on August 25 in the Waswanipi Lake region of western Quebec where he was engaged in geologic field work for the summer with the Quebec Bureau of Mines.

DR. JOSEPH BURTT-DAVY, South Africa, late university demonstrator in forestry at the University of Oxford and lecturer in tropical forest botany at the Imperial Forestry Institute, of Shotover Furze, Headington, died on August 20. From 1903 to 1913 he was government agrostologist and botanist in the Department of Agriculture, Pretoria. He had previously served on the staffs of the Royal Botanic Gardens, Kew, of the University of California and of the U. S. Department of Agriculture.

DR. C. F. JENKIN, who was elected the first professor of engineering science at the University of Oxford in 1908, a post he held until 1929, died on August 2.

THE death is announced of Dr. John Sydney Edkins, formerly lecturer in physiology at St. Bartholomew's Hospital and professor of physiology in the University of London.

R. C. MOSSMAN, meteorologist of the Scottish National Antarctic Expedition and climatologist to the Argentine Government, died on July 19 in his seventieth year.

SIR H. C. HAROLD CARPENTER, professor of metallurgy in the Royal School of Mines of the Imperial College of Science and Technology, South Kensington, died on September 14. He was sixty-five years old.

THE men's dormitory at the Michigan College of Mining and Technology has been named Douglass Houghton Hall in honor of Douglass Houghton (1809–1845) who was the first state geologist of Michigan and the first man to stress the wealth and importance of the Upper Peninsula. Brief dedication ceremonies this summer included an address by the Honorable A. E. Petermann of Calumet, chairman of the board of control of the college. The residence hall was opened for use in September, 1939.

SCIENTIFIC NOTES AND NEWS

ACCORDING to an Associated Press dispatch Sir Joseph Thomson, who died on August 30, was buried on September 4 in Westminster Abbey near the graves of Newton, Darwin, Faraday and Rutherford.

Dr. **Jean H. Vincent**, professor of epidemiology in the Collège de France, formerly inspector-general of the Health Service of the French Army, has been elected vice-president of the Paris Academy of Sciences.

Professor **W. H. Hoffmann**, of the Finlay Institute, Habana, Cuba, has been elected an honorary member of the Colombian Society for Leprosy of Bogotá.

At the opening ceremonies on August 21 of the twelfth International Veterinary Congress, held in Washington, the congress prize for 1940 was presented to Dr. I. Forest Huddleson, research professor of bacteriology at the Michigan State College. The prize is awarded each year to "a member of the American Veterinary Medical Association whose work reported during the year has been the most outstanding and valuable to the advancement of veterinary science."

Dr. **Charles Greeley Abbot**, secretary of the Smithsonian Institution, and Watson Davis, director of Science Service, received the Goodrich Award for Distinguished Public Service in recent ceremonies at the New York World's Fair.

The Collecting Net reports that Dr. Donald H. Barron, lecturer in biology at St. John's College, Cambridge, has been appointed assistant professor of zoology at the University of Missouri. Because of the difficulty of carrying on research in England at the present time, Dr. Joseph Barcroft, with whom he worked in England, is sending to Dr. Barron most of his research material.

Professor **Angel H. Roffo** has been appointed the incumbent of the new chair of "cancerology" of the faculty of medicine of the University of Buenos Aires.

Dr. **Lemen J. Wells**, since 1938 assistant professor of anatomy at the School of Medicine of the University of Missouri, has been appointed associate professor of medicine at the Medical School of the University of Minnesota.

Dr. **Margaret D. Craighill**, of Greenwich, Conn., has been appointed acting dean of the Woman's Medical College of Pennsylvania, to fill the vacancy caused by the retirement of Dr. Martha Tracy.

At the New York Post-Graduate Medical School of Columbia University, the following have been made heads of departments: Dr. Henry H. Ritter has been placed in charge of the department of traumatic surgery; Dr. George Anopol in charge of the department of orthopedic surgery, and Dr. Irving S. Wright in charge of the department of medicine.

Dr. **R. H. Walker**, of the Utah Agricultural College and Experiment Station, who has been dean of the School of Agriculture and director of the station since April, 1938, resigned as of July 1 to become the director of the U. S. Regional Salinity Laboratory at Riverside, Calif.

Dr. **Roger B. Corbett**, of the University of Connecticut, who was recently named the director of the University of Maryland Experiment Station, assumed his new work at College Park on September 1. Dr. Corbett succeeds Professor J. E. Metzger, who died suddenly while on a motor trip to Florida for his health last winter.

Dr. **Donald M. Hatfield**, formerly instructor in economic zoology at the University of Minnesota, has been appointed curator of mammals in the museum of natural history of the Chicago Academy of Sciences.

E. W. **Schoeffel**, for four years microchemist with the American Medical Association, has resigned to accept an appointment in the research department of John Wyeth and Brother, Inc.

Dr. **Benjamin G. Horning** has resigned as health officer of Hartford, Conn., to become associate field director of the American Public Health Association for the United States and Canada.

W. **Richison Schofield**, chief engineer of Leeds and Northrup Company, Philadelphia, has been appointed director of engineering. John W. Harsch, assistant chief engineer, has been advanced to the position of chief engineer, and Mr. Harsch's former position has been filled by the promotion of John F. Quereau.

Sir **Rupert Briercliffe**, director of the British Medical Service in Nigeria, has been selected for appointment as the medical adviser to the comptroller for development and welfare in the West Indies.

The Committee of British Privy Council for the Organization and Development of Agricultural Research has made the following appointments to fill vacancies on the Agricultural Research Council: Sir Robert Blyth Greig, and, after consultation with the president of the Royal Society, Professor W. W. C. Topley, Professor E. J. Salisbury and Professor T. J. Mackie.

The title of professor of physics applied to medicine in the University of London, with the status and designation of appointed teacher, has been conferred on Dr. W. V. Mayneord in respect of the post held by him at the Royal Cancer Hospital, London.

Dr. **Charles W. Harwell**, since 1921 a member of the staff of the School of Medicine of Emory University and since 1923 assistant professor of micro-anatomy and neuro-anatomy, has resigned to become a fellow in public health at the University of North Carolina.

THE Field Museum Paleontological Expedition of 1940, led by Paul O. McGrew, assisted by John Schmidt, Ellsworth Shaw and Henry Horbeck, has been working for the past several months collecting specimens of the fossil fauna of South Dakota and Nebraska and has returned to Chicago with an extensive collection. Especially productive of specimens were deposits known as the Rosebud Beds in South Dakota, which are lower Miocene formations cut through by miles of canyons.

DR. G. M. SCHWARTZ has been granted leave of absence from the University of Minnesota for the academic year 1940–41. He will act as visiting professor in economic geology at the School of Mines recently established by the Faculty of Science of the University of Laval, Quebec.

IT was stated in SCIENCE for August 30 that applications for the Lewis Cass Ledyard fellowship award of the Society of the New York Hospital closed on September 15. This date is incorrect. Applications can be received up to December 15.

A SYMPOSIUM on the Physics of Rubber, sponsored by the Ohio Section of the American Physical Society, will be held at Akron, Ohio, on October 11 and 12. Tours through rubber factories and research laboratories will occupy the afternoon of Friday, October 11. Professor P. Debye, since June 1 chairman of the department of chemistry of Cornell University, will give a lecture on Friday evening at the University of Akron on "Physical Methods for Investigating the Structure of Molecules." On Saturday morning at 9:30 the symposium proper will be held at the university. This is the first of a proposed series of annual symposia, each dealing with physics as exemplified in a leading industry of the State of Ohio. The sponsoring organization, the Ohio Section of the American Physical Society, took its present form last year, having been preceded by the Central Ohio Physics Club, organized in 1926. The officers of the section are: *Chairman,* Paul E. Martin, Muskingum College, New Concord; *Vice-chairman,* W. E. Forsythe, Nela Park, Cleveland; *Secretary-Treasurer,* R. H. Howe, Denison University, Granville; *Program Committee,* R. S. Shankland, *chairman,* F. F. Householder and H. P. Knauss.

THE New York Academy of Medicine announces the availability of the Louis Livingston Seaman Fund for the furtherance of research in bacteriology and sanitary science. Fifteen hundred dollars may be awarded for assignment in 1940. This fund was established by the will of the late Dr. Louis Livingston Seaman and is administered by a committee of the academy which will receive applications from either institutions or individuals up to October 15. Communications should be addressed to Dr. Wilson G. Smillie, *chairman,* 2 East 103rd Street, New York. The fund will be expended only in grants for research in bacteriology or sanitary science.

A COOPERATIVE arrangement between the Newark College of Engineering and the Graduate School of Stevens Institute of Technology has been announced by Frank C. Stockwell, dean of the Graduate School at the institute. According to this cooperative plan certain of the advanced evening courses offered by the Newark College of Engineering for the academic year 1940–41 are coordinated with the offerings of the Graduate School at Stevens. Graduate engineers who satisfy the admission and academic requirements of the Newark College of Engineering and Stevens Institute of Technology may register and earn graduate credit in these courses administered and given by members of the instructing staff of the Newark College of Engineering, and this credit may be applied toward meeting the requirements of the degree of master of science at Stevens. A maximum of ten credits may be received by any student for such courses. The graduate courses offered at Newark under this cooperative arrangement are in the fields of mathematics, chemical engineering, civil engineering, economics of engineering, electrical engineering and mechanical engineering.

THE problem of student health will be stressed at Cornell University when an expanded program of medical examinations, medical care and intramural sports is put into effect this autumn. The health program has been strengthened by the recent appointment of Dr. Norman S. Moore as clinical director and physician-in-chief to the University Clinic and Infirmary. He is now assembling a staff for which new quarters are being prepared in readiness for the opening of the university on September 23. Dr. Moore will supervise the medical care and hospitalization given to all students in the University Clinic and the Infirmary. A slightly increased student health fee will take care of the additional services. Dr. Moore will coordinate his program with that of Dr. Dean F. Smiley, medical adviser, whose staff will continue to be responsible for medical examinations of all students and for the work in hygiene and preventive medicine.

IN order to provide facilities for the production of optical instruments and optical parts required by the National Defense Program, the Spencer Lens Company, the Scientific Instrument Division of the American Optical Company, has let a contract to the Gill-more-Carmichael-Olson Company for the construction of additional buildings. One unit of approximately the same size as the present Mechanical Parts Plant, completed last summer, will house certain prism and lens manufacture. A connecting unit two and three stories high will be utilized for the assembly of special contract work. A third unit will provide expansion for the mechanical parts operations. The new buildings will be of the same general type of construction as the unit completed last year, and will involve the latest developments in heating, lighting, plant layout, flexibility for expansion and changes, and working conditions and facilities contributing to the welfare of employees. Approximately 130,000 square feet of additional floor space will become available through this new construction. A million and a quarter dollars will be expended in carrying through the current program.

Information has been received from Switzerland stating that the Herbaria of the Muséum d'Histoire Naturelle, Paris, which contains collections of great interest to American plant taxonomists, are all in good condition. The herbaria, which after the outbreak of the war had been divided among three castles near Paris, are now being returned to the Muséum.

At a Congregation of the University of Cambridge on August 3 an emergency statute was made to allow, during the emergency, a professor to be a tutor, assistant tutor, bursar or assistant bursar of a college, either for an unspecified or for a specified period, provided that any leave so given shall end with the period of emergency, and shall be subject to such deduction from the professor's professorial stipend as the General Board, with the concurrence of the Financial Board, may determine in the particular case.

DISCUSSION

THE NAME CLAIBORNE IN GEOLOGIC LITERATURE

In a recent number of *The Journal of Paleontology*[1] the suggestion was made to abandon the name Claiborne for the famous "sands" of the Claiborne bluff, Alabama, "now that the Gosport [Claiborne] proves to be Moodys" [Jackson] p. 339. Before abandoning the name Claiborne for these famous "sands" and applying it to a lower, different, horizon and substituting the Mississippi name Moodys for Claiborne "sands" (and thus bring about needless confusion in our Tertiary literature) should not the above suggested correlation be proven beyond doubt, and if proved should there not be a careful consideration among Tertiary workers as to the most feasible nomenclatorial changes to be made?

The stratigraphic basis for this new departure would seem to be summed up on page 338 of the author's article, which reads:

> The Gosport [Claiborne] and Moodys [Moodys Branch marl] represent the deposits of a transgressing sea that first invaded the Claiborne area, bringing with it some representatives of the Lisbon fauna as well as several large, conspicuous species (*Venericardia alticostata, Crassatellites alta*, etc.) that have not been found in Mississippi. Later the transgression continued westward into Mississippi carrying a transition fauna, which, in turn, was succeeded by the typical Jackson fauna at the base of the formation at Moodys Branch.

With but slight emphasis on the word "later" in the above quotation, the sequence of events suggested is precisely that we had in mind in our note "Age flow and ebb of Eocene seas."[2] In both citations the Claiborne is admitted to have been deposited before the Moodys Branch Jackson. If so, how can "the Gosport [Claiborne] prove to be Moodys"?

From a paleontological standpoint (dealing now, however, only with the Mollusca) a few facts may be mentioned.

1. Miss Julia Gardner's article "Recent collections of Upper Eocene mollusca from Alabama and Mississippi," immediately following Cooke's in the *Journal of Paleontology* above cited, indicates that about 10 per cent. of Claiborne (Gosport) fossils are found in the later Eocene formations.
2. Our studies of the Turrids so far as now conducted seem to indicate a much smaller proportion of species in common.
3. Of Venericardia planicosta-like forms, Gardner and Bowles[3] find no representatives passing from Claiborne to Jackson beds though one ranges from Lower to Upper Claiborne.
4. In Bowles's article on Turritellas[4] we note no form of this genus in common from these two horizons.
5. In our studies of the Pelecypoda of the Claiborne and St. Maurice stages about 18 per cent. are found in common between these two stages.[5]
6. Mrs. Palmer's work on the Gastropoda[6] shows about 19 per cent. in common between the same horizons.

Hence, so far as mollusks are concerned there appears to be about twice the percentage in common between the St. Maurice (Lower Claiborne) and Claiborne, as between the latter and the Jackson. Moreover, the marked individualistic character of the true Claiborne molluscan fauna apparently precludes its amalgamation with either the St. Maurice or Jackson beds, especially the latter.

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[1] C. Wythe Cooke, *Jour. Paleont.*, 13: 337–339, 1939.

[2] Science, 48: 646, 1919.

[3] Julia Gardner and Edgar Bowles, *U. S. Geol. Surv., Prof. Paper* No. 189F, chart 2, 1939.

[4] Edgar Bowles, *Jour. Paleont.*, 13: 267–336, 1939.

[5] G. D. Harris, *Bul. Am. Paleont.*, 6: 268, 1919.

[6] K. V. Palmer, *Bul. Am. Paleont.*, 7: 730, 1937.

Forty-odd years ago we observed *Mitra millingtoni* and *Aturia* in the impure limestones just above the "sand" at the Lower Claiborne bluff suggesting that here might be the position of the Moodys Branch marl though now generally classified as basal "Ocala." We hope to refer to this subject again in the near future. At any rate, let us not drastically modify our Eocene stratigraphic nomenclature until more evidence is presented requiring such modifications.

G. D. HARRIS
PALEONTOLOGICAL RESEARCH INSTITUTION,
ITHACA, N. Y.

THE MUSEUM AND SOCIAL ENLIGHTENMENT

YOUR readers surely approve of Dr. Goldstein's argument, published in SCIENCE (August 30, 1940), that museums should be potential forces for social enlightenment. Some of his proposals, however, are already realities.

When I was there last the Deutsches Museum, the masterpiece that the late Dr. Oskar von Miller created in Munich, had thirty-three motion-picture machines which explained factory processes. A very large proportion of the exhibits were of the dynamic variety for which Dr. Goldstein pleads; that is, the visitor could push buttons and pull levers, make the wheels go round and see for himself how sectioned locomotives, engines and other machinery worked. Von Miller's principles have been followed both here and abroad in technical museums. It may interest Dr. Goldstein to know that von Miller conceived the idea of the planetarium and installed the first one in his museum.

Yet it must be conceded that no museum in the world interprets its exhibits both technically and socially. Surely it is not enough to install a model of an elevator and watch it go up and down as a button is pushed. The elevator created the skyscraper and hence Rockefeller Center. When a single huge office building discharges 50,000 on the sidewalk at five o'clock a problem in transportation is created which the engineer must solve. That, too, is part of the elevator's social story. And so with the cotton gin, which revived a dying slavery in this country and was the occasion of our high tariff policy, and with the steam-engine of Watt, which gave us the slum.

Especially vulnerable to attack is the natural history museum—usually a storehouse of exhibits. It should begin with the solar system and show by motion pictures of the animated cartoon type how a great star wanders in our part of the heavens and by sheer gravitational attraction pulls out of the solitary sun long streams of gas which curl into spirals and eventually congeal into planets.

We are now prepared for geology and geophysics. So we pass into an adjacent hall and see how this cooking, heaving earth became what it is to-day—see with the aid of operative models that we may work ourselves how mountains, continents and seas were formed, learn something of the seismic forces that are still molding the earth, behold miniature volcanoes spouting imitation lava and ashes and burying Herculaneum and Pompei.

In the next division the curtain goes up on the drama of life. The first bit of protoplasm is born in a puddle on this congealed earth. Microscopes on every hand reveal primitive living forms. Or Dr. Roemmert's microvivarium, which made such a success at the Chicago and New York World's Fairs, could be used here with even greater dramatic effect.

We move on and learn what becomes of this protoplasm. The first backbone appears. Reptiles, birds, mammals follow. At last come the anthropoid apes. *Homo sapiens* is in sight. His origin is obscure. But he is seen emerging in such experimental forms as *Pithecanthropus erectus*, the Peking Man, the specimens found in Sussex, England, Rhodesia, South Africa. This evolution of life is shown by the diorams now so highly developed, stuffed animals, skeletons, single bones, but above all by motion pictures.

Having created man we pass into the anthropological division and see what he has made of himself—see the Cro-Magnons experimenting with art, the Swiss lake-dwellers building their houses on piles and learning to weave. Roman bathtubs, mummies, totem poles, click into their logical places. But the end is social man—man, a free agent, dominating his environment. From the birth of the solar system to man—what a story!

It may be argued that all we have done is to rearrange familiar exhibits and compel the visitor to follow a definite route, to present more diorams, more dynamic models, more motion pictures. True. But we are also more evidently progressing from star to man. Slimy puddles and extinct dinosaurs appear more obviously as preparations for the emergence of man. The totem poles and the mummies are clearly ripples in the current of biological and social evolution.

The most ambitious museum ever planned but never erected was that of Le Corbusier and Paul Otlet. In their vast pyramid there is not a staircase—only ramps and elevators. You begin your journey at the apex. There you see the first man with nothing but his hands and his brains. You spiral your way down and behold him acquiring new abilities, learning how to fashion tools, how to cultivate the soil, how to weave. Further on he gathers into stable communities. Nations spring up. Always winding downward, the path leads to new proof of man's ability to evolve socially and to change his environment. The spiral widens as it slants down and down, so that there is an ever-expanding space for the ships, the machines, the art, the houses that man created in his progress through the ages. At the bottom of the pyramid you find yourself on the sidewalk in the twentieth century, in the midst of a modern city, with its electric lights, its buses, its subways, its airplanes.

That museum was almost built in Geneva. I am told that political bickerings prevented its realization. Had it been built it would not only have satisfied Dr. Goldstein's cogent requirements but played its part in revealing what the nations of to-day owe to one another and to the past.

WALDEMAR KAEMPFFERT

THE NEW YORK TIMES

SPHALERITE AND GALENA IN SEDIMENTARY ROCKS IN OHIO

RECENTLY, while making a study of the sedimentary formations of Mississippian age, in a quarry located in the city of Wooster, Ohio, the presence of sphalerite and galena was discovered in a horizon within the Cuyahoga formation. These minerals occur as crystals in the shale or as fillings or replacements of fossil forms such as crinoid stems or brachiopods. They are also present in fossiliferous concretions associated with iron pyrite and calcite. The sphalerite is much more abundant than the galena and appears to occur where fossils are numerous. The concretions are calcareous because of the abundance of the crinoid and brachiopod shells.

Near Marshallville, Ohio, in the railroad cut near that place, the Pottsville formation of lower Pennsylvanian age is exposed. In the shale beds occur numerous concretions, some of which, when broken, show sphalerite associated with iron pyrite, calcite and barite. These concretions are likewise fossiliferous.

There are other places in Ohio where sphalerite and galena occur in sedimentary rocks. These occurrences may have some value to students interested in the theories of the origin of sphalerite and galena ores, such as those of the upper Mississippi valley.

KARL VER STEEG

COLLEGE OF WOOSTER

A NEW SOURCE FOR AGATE ARTIFACTS IN CENTRAL NEW MEXICO

IT is commonly assumed that agate artifacts found in central New Mexico are derived exclusively from the river gravels of the area in which agate pebbles are fairly abundant. Continued geologic study of the region indicates that some of them were derived from rock in place. Cerro Colorado, a small but prominent hill approximately 14 miles west of Albuquerque in the valley of the Rio Puerco, is the remnant of a volcano of Tertiary time. It was clearly such a source of agate. Its rough, rhyolitic slopes are cut by narrow, irregular veins of gray to white chalcedony or agate. This material is not entirely homogeneous in texture, and the largest available masses are only 3 or 4 inches in diameter, yet it is suitable for making artifacts. That this material has been so used, presumably by the Indians, is shown by the presence in the locality of spalls and worked pieces. The veins of chalcedony are too narrow and irregular for systematic quarrying. However, they weather less readily than the bedrock and project above its surface as tiny ridges. Fragments of the chalcedonic veins eventually weather out and drift down the slope, where they are available for use. It also seems probable that the projecting veins were broken off by the agate users of the past.

FRANKLIN T. MCCANN

DAYTON, OHIO

SCIENTIFIC BOOKS

HORTICULTURAL PLANTS

Propagation of Horticultural Plants. By GUY W. ADRIANCE and FRED R. BRISON. ix + 314 pp. 182 figs. New York: McGraw-Hill Book Company. 1939. $2.50.

A KNOWLEDGE of the fundamentals of propagation of plants is recognized as something essential to good horticultural practice, and in recent years this subject has been involved in many research projects. The results of such investigations have contributed to both science and practice.

This book has been prepared primarily as a text for horticultural courses in college. There are seventeen chapters arranged as follows: Introduction; Seeds; Flowers and Fruits; Germination of Seeds; Forcing Equipment; Asexual Propagation; Bulbs and Related Structures; Layerage; Cuttage; Graftage; Grafting Waxes, Materials, and Tools; Methods of Grafting; Methods of Budding; Propagation of Certain Plants; The Relation of Propagation Practices to Diseases; Transplanting; Growing and Handling of Nursery Stock.

A glance at the chapter titles shows that the authors chose to handle various phases of the subject at random rather than to organize it under the main divisions, sexual and asexual propagation.

Each chapter is followed by a set of questions and a few "suggested references." At the end of Chapter III the following questions are asked: 1. What is an inflorescence? 3. What is the distinction between a fruit and a seed? Between simple, aggregate and multiple fruits? 5. Give examples of accessory fruits. What tissue comprises the edible part of each? Chapter VII has the following questions: 2. What are the distinguishing features of true bulbs? 3. In what way does a true bulb resemble a dormant bud in structure? 14. How do the sweet potato and the Irish potato differ in structure?

Those of us familiar with duplications in agricultural college courses can readily see from the nature of the questions cited that students will have had the same questions asked in general botany and elementary horticultural courses before they get to a special course on propagation. Though the criticism is offered, the reviewer knows no solution. Books on "Floriculture," "Pomology," "Vegetable Gardening," etc., usually carry a chapter or more on propagation of plants involved in the particular field. Whether or not such conflicts can be ironed out the reviewer is unable to say.

This book has a large store of compiled information, and the authors have made an effort to bring it up to date.

P. W. ZIMMERMAN

BOYCE THOMPSON INSTITUTE

INDIAN CORN

The Origin of Indian Corn and Its Relatives. By P. C. MANGELSDORF and R. G. REEVES. 315 pp. 93 figs. 40 tables. Texas Agric. Expt. Sta. Bull. 574. 1939.

LIVING in an obligate relationship with man and having covered its evolutionary tracks most successfully, the Indian corn plant presents an unusually interesting problem of origin and relationships. It is undoubtedly closely related to the two American grasses, *Tripsacum* and teosinte, but the exact relationship is obscure, and the picture of the wild ancestral form is wholly theoretical.

One theory makes teosinte the ancestor and assigns to the Indian the role of plant breeder, another has corn, *Tripsacum,* and teosinte develop from a common ancestor; and a third proposes a hybrid ancestry between teosinte and some other grass of hypothetical nature. Each of these has some shortcomings, but none of them can be entirely disproved.

By an ingenious technique, Mangelsdorf and Reeves have hybridized corn with *Tripsacum,* and the nature of the hybrid, supplemented by other data, suggests to them that teosinte originated, probably very recently, from a natural cross between these genera. The technical analysis, full details of which are given in an excellent manner, shows a close relationship between the characteristics of the various segregates and the presence of certain *Tripsacum* chromosomes, and teosinte is pictured as essentially corn to which certain genes of *Tripsacum* have been transferred.

This removal of teosinte from consideration in any ancestral relationship extends the possibilities as to the place in which corn originated, and attention is again turned to South America, where the highly developed agriculture of the Incas and the reports of early explorers are thought to afford promising evidence.

This addition to our collection of theories about these plants makes full use of important new data but does not necessarily preclude any of the older theories. It hardly fulfils the implication of the title of the book, for it adds nothing to our knowledge of the wild corn plant except to cast some doubt upon the claims of teosinte. To assume, as this theory does, that pod corn is the most promising lead back toward the wild ancestor leaves us exactly where we have been for a long time. Pod corn has primitive characters, but it is difficult to know whether they represent original or derived conditions, and, at best, it is not sufficiently different from the naked-fruited varieties to answer the requirements of the self-supporting wild plant.

PAUL WEATHERWAX

INDIANA UNIVERSITY

REPORTS

A STATEMENT TO THE BOARD OF TRUSTEES OF THE MUSEUM OF SCIENCE AND INDUSTRY, CHICAGO

FACED with a demand by the newly elected president of the Museum of Science and Industry for my resignation, a demand which he termed "irrevocable," I prepared the following statement dated August 22 for the Trustees for their meeting of August 26, 1940. Letters in regard to my appointment to the directorship are omitted and several minor alterations in the text have been made. Deletions are in general indicated by leaders, additions by enclosure in brackets.

Since 1 May 1937 I have served as director of the Museum of Science and Industry with singleness of purpose toward its welfare. I have held steadfastly to the aim that its exhibits should show primarily the dependence of our modern civilization on science and on its application in industry. Not only that this understanding be driven home, but that there should be clear presentation of the methods by which science approaches its problems, the attainments, the methods of application, the way of progress, what problems are pressing for solution. Moreover that there should be created an atmosphere of vivid alertness and inspiration.

This purpose was held in view as the interior construction progressed, it is woven into the very structure of the building. The theme is epitomized in the legend at the base of the great central dome: "Science Discerns the Laws of Nature—Industry Applies Them to the Needs of Men." It appears also in the panels of the great doors at the main entrance and in the sculptured plaques in the entrance lobby, conceived by the director, developed by staff members, and executed by staff artists. Inspiration may come also from the names of great men of science, invention, industry, which appear as a decorative frieze about the whole length of the four great halls. Throughout the whole Museum, in every hall, the plan is revealed in clear-cut exhibits of meticulous scientific accuracy, many visitor-operated, and many of high artistic merit.

Naturally, in the last three years the expenditures have mounted for, first, the operating part of the Museum was moved from the unfinished central section to the West Pavilion, then, with the completion of the building, space became available for the definitive installation of exhibits. Shop crews were greatly increased; additional carpenters, machinists, electricians, painters, laborers, were employed. Also, the number of demonstrators was increased, and additions were made to the boiler room crews, and to the force of janitors. Purchase of furniture and fixtures and equipment, of special exhibits, such as The Periodic Table of the Elements, services to exhibits (electricity for light and motors, gas, compressed air, water, drains) hundreds of feet of exhibit cabinets and supports and railings added to the cost.

Every dollar spent has been most carefully considered. Every major project was reviewed with Mr. Dawes before it was taken to the shop or placed with an outside contractor. And may I say also that all work, as it proceeded, met with Mr. Dawes' approval. In no Quarter did expenditures exceed budgets authorized in advance by the Trustees. As a matter of fact, each *approved* quarterly budget of the last two years exceeded actual expenditures by a margin of some thousands of dollars. Now that preparations are nearing completion, the major items of furniture and equipment purchased, the budgetary demands could be sharply reduced. The figure for the current quarter is $33,000 less than that for the previous quarter; this clearly indicates the trend. [The money outlay in the months when a house is being built and furnished exceeds the cost for a like period of occupancy.]

The minimum annual budget figure that I had considered is $275,000. I reviewed a summary based on such an estimate with Colonel Sprague, vice-president, then acting president. This entailed reduction in salaries, my own most of all both in amount and percentage, and some reduction in staff, but with a curator for each department, and library open. A figure of $300,000 would have avoided serious cuts in salaries except for a few of the administrative staff, and would have permitted a more ample corps of demonstrators.[1]

But now, just as the Museum was on the final lap of its preparations, when it seemed most essential that the staff should put on the final spurt, the situation has completely changed.

At a meeting of the Trustees of 16 May 1940, Lenox R. Lohr was invited to become president of the Museum Corporation, at an annual salary of $25,000.

At a meeting of the Board of Trustees of 11 July 1940, Mr. Lenox R. Lohr was ". . . elected President of the Museum of Science and Industry to serve until the next annual meeting of the Board of Trustees and until his successor is duly elected and qualified, at a yearly salary of $25,000, said salary to be paid from the Special Promotional Fund, and payments on said salary to begin July 15, 1940."

I cite these actions, calling especial attention to the dates. Mr. Lohr was elected President on 11 July 1940, to take office on 15 July 1940.

Mr. Lohr visited the Museum on 8 July. It was my privilege to assemble the members of the staff and present them to the new president and to offer to him for myself and on their behalf a pledge of cooperation.

On 10 July, one day preceding Mr. Lohr's election to the presidency, I received from Colonel F. C. Boggs, secretary, the following communication:

> *My dear Fox,*
>
> Several times yesterday and today I was on the point of speaking to you on a subject which has worried me for some time and particularly so since Lohr's visit. . . .
>
> As you probably inferred from what Lohr said, he intends to keep in direct contact with all members of the staff and hold matters pretty well in his own hands. In other words, from what he said and from my knowledge of his methods of work, I am sure he will take over practically all the work you have been doing.
>
> The question immediately arises—is there any need in the organization for two active heads—the answer seems apparent.
>
> For your own sake it seems that any initiative in the matter should come from you, and, best before Lohr actually takes charge. . . .
>
> I hope you will believe me when I say that the writing of this note has been the hardest thing I have had to do for a long time and that I am doing so only in your interests and for your future protection.
>
> Sincerely
> B

I went immediately to Colonel Boggs' office and inquired directly if Mr. Lohr had instructed him to write the communication. The answer was in the affirmative. I told him that the request for my resignation was a shocking thing, received without any forewarning, without recognition of need either budgetary or otherwise, that I must take time for consideration. I failed to see how my interests might be served or how I could be protected by committing scientific suicide, I could not take the hemlock so resignedly. I considered that since I was elected by the Trustees, only they were competent to terminate the appointment. I wished to know if the request had been made with their knowledge and authorization.

In conversation with Mr. Lohr on 26 July, he renewed his request for my resignation. Asked for the reason, he stated only that his method of working called for direct approach to the curators, that in essence he intended to carry the combined duties of president and director. He professed deep friendship for me and respect for my attainments. He stated that he had delayed his decision on

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[[1] This sum is within a reasonable span of the expected income from various sources. The existing cash reserve could bridge the gap for from six to ten years under the moderate scale of operation. In that time the Museum would have amply demonstrated that it merited support.]

the invitation to become president for two months while he pondered the problem of the severance of my appointment as a necessary consequence of his acceptance. He informed me that he had discussed this matter with many of you, the Trustees. On consultation with the vice-president, I learned that he had no knowledge of Mr. Lohr's intention and I later learned that others of the Board were uninformed. You will know among yourselves how widely this intention was known. I stated to Mr. Lohr, and I repeat here, that if this consequence was with Mr. Lohr a *sine qua non*, this fact should have been clearly and unequivocally stated to the Board that it might have been weighed in arriving at a decision.

On 2 August twelve members of the staff received from Mr. Lohr notice of dismissal from Museum service, to be effective 15 August:

Dr. F. C. Brown	Curator of Physics
Dr. C. R. Moulton	Curator of Chemistry
J. A. Folse	Curator of Power
R. B. May	Curator of Transportation
Trent Sanford	Curator of Architecture and Civil Engineering
Helmuth Bay	Asst. Curator—Forestry
John A. Maloney	Public Relations
Miss Mary B. Day	Librarian
Erik Fenger	Staff Engineer, Electrician
Harry Berkowitz	Assistant to Mr. Fenger
Walter Baggeson	Asst. in Engineering Department
Emil Rauschenberg	Shop Foreman

I could speak a strong word for each person dismissed, for the curators of physics and chemistry, men of scholarly attainments, each with the Ph.D.; for Mr. May, who has had peculiar success in enlisting cooperation of the transportation industries; for Mr. Sanford, an architect of rare artistic taste. It is perhaps most difficult to see how Mr. Folse, the ablest and most versatile engineer on the staff, can be spared. His revision of the heating and ventilating system resulted in savings in cost of installation of many thousands of dollars and more than his salary in annual operating costs. He has served the Museum devotedly for twelve years. Similar commendation might be made of Mr. Fenger, whose careful attention to the electrical circuits has resulted in great savings.

When the first university of the world, as we now think of a university, was organized, at Alexandria, the library was an essential feature. For a thousand years, this famous library and associated museums and lecture halls was the center of world culture. Mr. Lohr's dictum to close the library, his dismissal of the librarian, is in strange contrast to the enlightened Alexandrian practice. I can assure you that the library had particular appeal to Mr. Julius Rosenwald. Miss Mary B. Day, who has been in charge of the library from its beginning and responsible for its excellent organization, is a technical librarian of high efficiency. Alexandria was great because scholars were there; Euclid, Archimedes, Apollonius, Theon, Hypatia, Diophantus, Hero, etc. The Museum of Natural History in New York, the Smithsonian Institution, the Field Museum are notable because scholarly men have made them so. [Salesmanship can bring support to educational and cultural institutions, but the devotion of scholars gives them their character.]

Surely, as the Museum is about to open, there can be no intention to lessen the activity of the publicity department. Why then should Mr. Maloney, a gifted writer, who has served the Museum for twelve years, who enjoys happy relationships with the press, who is familiar with every phase of the Museum's development and affairs, be dismissed?

Why should any of these dismissals be made at this time when the energies of all were being devoted to the final phases of preparation, when the dismissals sever many valuable contacts, lessen the impetus of the final drive? It is unfair that these persons are deprived of the privilege of welcoming the eager public to the halls they had given their talents to prepare. Why were they dismissed summarily at a time when there are no openings for university appointments? What was the basis for the arbitrary selection? It is difficult to discern reasons which would deprive five departments—Physics, Chemistry, Power, Transportation, Architecture and Civil Engineering—of their curators while three men are retained in the Department of Geology and Mineral Industries, and a fourth whose sole training is in that field. Though I, as director, was specifically assigned "full charge . . . of the operations of the Museum staff," I was not consulted in regard to the dismissals, either as to plan or the designation of individuals to go. Mr. Lohr knew very few of the dismissed group personally and none more than slightly, knew nothing directly of their characters or potentialities. If one were to look for the person who served as an analogy for Madame Defarge of the Reign of Terror, he would not have far to seek.

I did not have an opportunity to protest against the dismissals, but I do now protest vigorously, and protest also against the usurpation of authority specifically reposed in the director.

Construction on many exhibits has been interrupted, plans have been laid aside, preparation delayed, my instructions to the shop have been countermanded without consultation with me or even notification. The president announces that he will review all exhibits. Architects and "exhibits experts" have been called in to assist. "All labels will be rewritten" and reprinted. This means expensive delay and direct cost, which scarcely parses with the note of "drastic reductions for budgetary reasons." The shop force, which had been greatly reduced with the tapering off of work, has now been increased to effect the ordered alterations. May I say that at the time of Mr. Lohr's arrival the exhibits for the area proposed to be ready at the opening were nearing completion.

I believe that the trustees would wish to visit the Museum and see with their own eyes the character of exhibits and stage of preparations before accepting as necessary drastic revision of plans, to review carefully the initial basic principles which for twelve years have been rigorously adhered to before casting them aside.

The president has stated to me that he proposes to add certain persons [with promotional talents] to the staff. I foresee a gradual infiltration till presently the "budgetary need for reduction" will assume a different aspect.

What has taken place in your Museum in these first days of Mr. Lohr's presidency is an assault without parallel and without precedent in any American cultural institution. It is an affront to the intelligence of the community. It has started unfavorable comment in the scientific world; it has been termed a "blitzkrieg" and "Naziism" in the public press. If this dictatorial action can be tolerated in this Museum of Thought, in whose founder's character the keynote was the recognition of human values, what hope is there for American institutions in general? Ruthlessness can not in any guise be construed as a virtue.

I am your appointee, duly elected. In coming to the Museum I left a post in a worthy institution, resigned a civil service appointment with assured income and retirement allowance. I am fully aware of the "thirty days' notice" clause in the letter of appointment, but surely I was justified in the expectation of security of tenure which prevailed in every similar institution of the world until violated by Nazi and Fascist practice.

There has been no charge or intimation that I have been inefficient or incompetent, inattentive, careless, negligent, slothful, recreant in any wise in the discharge of my duties. There can be no charge of failure to cooperate with the new régime, for I have been given no opportunity to cooperate. I have given the same devotion to the Museum that in other years I gave to my university and observatory, and in military service to my country. I have taken pride in participating in the development of the Museum to an institution of beauty, power, and nobility. I have striven to interpret science so that we might apply wisely the powers it has provided, that we might know its spiritual value, and adopt its severe code of honesty and forthrightness.

If you, the trustees, believe that the Museum needs no longer the guidance which I have provided and have sought to make vigorous yet thoughtful and considerate, if you feel that you can not stanchly support your appointed director in the discharge of his duties as you have defined them, then perhaps you may wish to construe this Statement as a resignation. I trust that the board in taking action will be represented by more than a bare quorum.

The strength of the ideals of this institution and civic pride of Chicago are such that the Museum can not perish. In other days I have said to you that its purpose so clearly fulfils a need that support will flow to it naturally. It is not necessary to dismiss many men of loyalty and integrity, to cut close to its very heart and see it survive to prove that it has vitality.

In another place I wrote:

> We trust that this Museum may promote friendly understanding and mutual respect among those who engage in research, those charged with the development and management of new and established enterprises, those who invest their savings in them, the skilled workmen, and the general public. We hope that this institution may kindle in some youth the spark of genius, supply the clues to the solution of many problems, give to some craftsman the inspiration for invention, and to all who come within its walls realization of the majesty of thought and the nobility of labor.

The thought was expressed as a trust and a hope, but perhaps you will hold in mind that this was in reality my creed. In it you will find no grain of personal ambition, but rather the spirit of cooperation, the aspiration that our Institution might be a factor in promoting mutual understanding and uninterrupted progress. I shall stand ever ready to aid in its fulfilment.

I had had expressions of regret and disapproval of Mr. Lohr's action from some of the Trustees but I felt that if the Trustees were faced with an impasse as between the President and Director they would vote to sustain the newly elected official. The statement was construed as a resignation and as such it was accepted "effective at the close of business of September 30, 1940." The Trustees further adopted a resolution commending my energetic directorship and in recognition thereof authorized and directed the president to pay to me "a sum equivalent to six months' salary."

Philip Fox

SPECIAL ARTICLES

TICK-BORNE HUMAN ENCEPHALITIS IN THE EUROPEAN PART OF USSR AND SIBERIA

Within recent times a new virus disease of the central nervous system in man, the verno-aestival or tick-borne encephalitis, has been discovered and investigated in the Soviet Far East.[1]

The peculiar features distinguishing this variety of encephalitis from similar varieties, *i.e.*, the North American (St. Louis) and the Japanese summer-encephalitis, concern, first of all, its epidemiology. As a matter of fact it is transmitted by a peculiar vector, the *Ixodes* ticks (*Ixodes persulcatus*, Schulz, 1930, *et al.*) which were shown to carry the virus and to infect humans through a bite.

The disease is to a certain extent endemic for certain woody localities affecting mostly people engaged in forest work.

The maximum incidence falls on the end of May and the beginning of June preceding (in distinction to the Japanese and St. Louis encephalitis) the hot season and the mass appearance of mosquitoes. The causative agent of the disease, the neurotropic filterable virus,[2] closely resembles in all its properties that of St. Louis and of the Japanese encephalitis except for its antigenic structure and certain other peculiarities.

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[1] (1) A. G. Panov, *Z. nevropatol. i psikhiatr., Moscow*, 7: 6, 18–32, 1938; (2) A. N. Shapoval, *Ibid.*, 7: 10, 74–80; (3) E. N. Levkovich, A. K. Shubladze, M. P. Chumakov and K. D. Soloviev, *Arkh. Biol. Nauk*, 52: 1, 162–183, Moscow, 1938; (4) M. P. Chumakov and S. G. Gladkikh, *Bull. Biol. et Med. Exp. USSR*, 2–3, 7, Moscow, 1937; (5) M. P. Chumakov, *Z. Mikrob. i Epidem. Moscow*, N 4, 1939; (6) A. A. Smorodinzev, E. N. Pavlovsky, M. B. Krol, *et al.*, Reports to the Union Microbiol. Conf., 1939 (in press); (7) L. A. Silber, V. L. Olshevskaya, *et al.*, *Arkh. Biol. Nauk.*, 56: 2, 1939.

So far it has generally been accepted that the tick-borne encephalitis of man occurs only in thick forest (*taiga*) of the Far East. This view is partly refuted by our findings that similar diseases may occur beyond the woodland zone of the European part of the Soviet Union. The question is thus raised as to a more wide occurrence of these diseases, not only in the Soviet Union but in other countries as well, where the corresponding natural conditions and the *Ixodes* ticks are present.

In examining, May, 1939, two sera of blood of humans recovered from the so-called atypical poliomyelitis of adults (Perm district) the senior of the writers found a high content of antibodies to the Far-East strain of the virus of the tick-borne encephalitis of man.

This finding led us to a more extensive virusological (Chumakov) and clinico-epidemiological examination of the affections of the central nervous system diagnosticated as "atypical poliomyelitis," "serous meningitis," "post-grip encephalitis," the "Kojevnikov epilepsy," etc.

Through the collaboration of local neuropathologists we have learned that in several districts of the Soviet Union (Belarussia, Perm, Kirov, Sverdlovsk, Cheliabinsk district, Western Siberia, etc.) there occur every year, sporadic cases and small localized outbreaks of diseases that are quite similar in the clinical picture and epidemiology to the Far East tick-borne verno-aestival encephalitis. Numerous tests of the sera of typical reconvalescents invariably gave positive results as regards neutralization of the virus of the tick-borne encephalitis.

The disease is characterized by acute beginning high temperature, vomiting, meningeal and general cerebral phenomena, obscured consciousness and frequently by the development of flaccid pareses, paralyses and muscle atrophy, mostly of the upper limbs, bracial girdle and neck.

The season of the incidence is May to September. The disease affects wood cutters, hunters and similar persons attacked in the forests by the ticks one to two weeks prior to the beginning of the disease.

Numerous ticks, *Ixodes persulcatus,* were detected in the local forests (including those situated in direct vicinity to large inhabited localities). These ticks showed great activity in attacking man.

We have succeeded in isolating from the brain of three persons deceased from encephalitis and from the blood of one patient at the height of the disease, four strains of the neurotropic filterable virus (Ural and its neighborhood).

A similar virus was also detected in the local ticks, *Ixodes persulcatus,* which proved naturally infected at all stages of development and readily infected mice on which they fed. Most of the strains (above twenty) were obtained through a bite. It was also found that these ticks collected at the stage of fasting imago and fed on laboratory animals give rise to an offspring (larvae nymphs) which contains a highly active virus. Hence, in the ticks the encephalitis virus is transmitted through the ovum and during metamorphosis; it apparently propagates in the ticks without doing them any particular harm.

In another series of studies carried out in collaboration with N. N. Vorobieva and N. E. Sofronova we have succeeded in detecting a similar virus (four strains) in the brain of wild rodents killed in the endemic focus, *viz.,* hares and squirrels which are attacked by the ticks—the virus vectors.

A large group of strains was studied in detail by means of the following additional methods: (1) cross neutralization of the virus with specific immune sera (of man and animals) and (2) cross vaccination of mice against infection. All the isolated strains were found to be identical to one another as well as to the Far East strains of the tick-borne verno-aestival encephalitis.

In isolating the virus from humans and animals advantage was taken of the widely applied method of preliminary enrichment of the test material by cultivating it on embryonic tissues in Carrel dishes (after the Maitlands) or by inoculating into developing chick embryos.

Thus it was shown for the first time that in the European part of USSR and in Siberia there occurs a peculiar virus disease, *viz.,* the tick-borne encephalitis of man. Further study is necessary of its geographic distribution and of its relation to other neuro-virus infections transmitted by insects.

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VITAMIN B_1 IN RELATION TO THE GROWTH OF GREEN PLANTS[1]

THE demonstration of the significance of vitamin B_1 in the growth of pea embryos[2] and excised pea[3] and *tomato*[4] *roots has raised the question of the role of* vitamin B_1 in the nutrition of higher plants. The point of particular interest is whether intact green plants capable of synthesizing this vitamin can profit from its additions to an inorganic growth medium. This is obviously different from a demonstration of the need of excised roots or other isolated tissue for vitamin B_1 as its synthesis in higher plants takes place in green leaves under the influence of light[5] and this vitamin may thus be regarded as another among the organic substances for which roots depend on shoots for their supply—a relation not dissimilar to the general dependence of animals on green plants.

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[2] References 3, 5 and 7, footnote 1.

[1] Since completion of these experiments the writer has been informed of extensive experimentation on this question now in progress at the United States Department of Agriculture laboratories at Beltsville, Maryland.

[2] F. Kögl and A. J. Haagen-Smit, *Zeit. Physiol. Chem.,* 243: 209, 1936.

[3] J. Bonner, SCIENCE, 85: 184, 1937.

Bonner and Greene[5, 6] have investigated the response of intact plants to additions of vitamin B_1 by treating a number of species grown from seed in soil and sand cultures with aqueous solutions of vitamin B_1 and found that certain plants (cosmos, cocklebur, mustard) responded with marked increases in growth, but that others (tomato, pea) were unaffected. In general, plants responding to additions of vitamin B_1 were characterized by a low concentration of this vitamin in the leaves in contrast with the high concentration found in the leaves of plants showing no response. The conclusion was reached by these investigators that the response of a given species to additions of vitamin B_1 is governed, in part at least, by the amounts synthesized in the leaves.

These findings seemed of special interest in the light of the experience of this laboratory, where many species of green plants have been grown with excellent results in metal or glass containers with inorganic nutrient solutions. The luxuriance of growth generally obtained under favorable environmental conditions without the addition of any organic nutrilites has lent support to the concept that under favorable climatic conditions and with an adequate supply of mineral nutrients and good aeration of the root system autotrophic plants are not limited in their growth by the inability to synthesize rapidly enough any of the essential organic growth substances. It was deemed desirable, therefore, to investigate under our conditions the effect of vitamin B_1 on several species of plants by growing them in carefully controlled nutrient solutions.

Among the plants selected tomato was already reported to give a negative response but cocklebur, cosmos and mustard a positive response[5, 6] to additions of vitamin B_1 when grown in sand or soil.[7] In the present experiments all plants were grown by the water culture method in nutrient solutions of the following compositions: KNO_3 0.005 M, $Ca(NO_3)_2$ 0.002 M, $Mg(NO_3)_2$ 0.001 M, $(NH_4)_2HPO_4$ 0.001 M, K_2HPO_4 0.001 M, H_2SO_4 0.0005 M. (The sulfuric acid acidified the phosphates.) A supplementary solution[8] furnished 0.5 ppm each of boron and manganese, 0.05 ppm of zinc, 0.02 ppm of copper and 0.01 ppm of molybdenum. The solution was analyzed from time to time to insure adequate concentration of nutrients and changed as needed. All the cultures save those of cosmos and cocklebur were aerated by means of sintered glass aerators (preliminary experiments indicated that these two species did not respond to supplementary aeration under the experimental conditions employed.)

In the light of the known effects of a number of elements in minute quantity on plant growth it was undertaken to safeguard against the introduction of such micronutrients either as small impurities in the vitamin B_1 solution or as chance contaminations in the process of adding the vitamin solution to some cultures. To this end the special technique for growing plants for investigations on micronutrients,[9] which involves the use of Pyrex containers, purified chemicals and redistilled water was employed. Furthermore, each addition of vitamin B_1 was accompanied by a parallel treatment with an autoclaved solution of equal concentration of vitamin B_1 rendered alkaline (to phenolphthalein) prior to autoclaving. This destroyed the activity[10] of the vitamin but afforded a means of testing the possible effect of inorganic contaminants.

With the exception of cocklebur, which was grown only during the spring, all the other plants were grown at two or more seasons, in a series of successive experiments extending for more than a year. Vitamin B_1 was added in concentrations of 0.01 mg to a liter of culture solution. In some cases 0.05 mg to a liter was added, but the results were essentially similar. Table 1 gives some representative results, as averages of dry weight in grams for each treatment.

TABLE 1

	Tomato		Lettuce		Cosmos		Mustard		Cocklebur	
	Shoots	Roots	Shoots	Roots	Shoots	Roots	Shoots	Roots	Shoots	Roots
Control	3.6	0.72	3.4	0.44	0.54	0.07	2.5	0.41	3.3	1.06
Vitamin B_1 added	3.7	0.72	3.6	0.47	0.58	0.07	2.8	0.32	3.6	1.12
Autoclaved Vitamin B_1 added	3.7	0.78	3.1	0.45	0.62	0.07	2.7	0.35	4.23	1.09

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[4] W. J. Robbins and M. A. Bartley, SCIENCE, 85: 246, 1937.

[5] J. Bonner and J. Greene, *Bot. Gaz.*, 100: 226, 1938.

[6] J. Bonner and J. Greene, *Bot. Gaz.*, 101: 491, 1939.

[7] The writer is indebted to Drs. E. J. Kraus and K. C. Hamner for furnishing the cocklebur and to Dr. James Bonner for the cosmos and mustard seed.

[8] The composition of this supplementary solution designated A5 is that of the previously described A4 solution (D. I. Arnon, *Am. Jour. Bot.*, 25: 322, 1938) plus 17.7 mgs of 85 per cent. MoO_3 per liter.

[9] P. R. Stout and D. I. Arnon, *Am. Jour. Bot.*, 26: 144, 1939.

[10] R. R. Williams and T. D. Spies, "Vitamin B_1 and Its Use in Medicine," Macmillan, 1939.

The results obtained do not support the view that, for the species investigated, intact plants grown from seed can benefit from additions of vitamin B_1 to an otherwise favorable nutrient medium. Such fluctuations in dry weight as were obtained are probably within limits of experimental error. It appears that under the conditions of these experiments the rate of vitamin B_1 synthesis was not limiting growth for any of the species investigated or, stated in other terms, such differences as do exist in the rate of vitamin B_1 synthesis among these plants are apparently compatible with their different needs.

Although these findings are regarded as favoring the contention that green plants when propagated under favorable conditions from seed are capable of synthesizing adequate amounts of vitamin B_1, they do not bear directly on the question of the effect of vitamin B_1 on the rooting of cuttings.[11] An important distinction should be made in this connection between sexual and vegetative propagation. The seed is a storage organ for vitamin B_1 (and is valuable for that among other reasons in animal nutrition) and other growth and food substances essential for the initial growth of the seedling, which soon embarks on photosynthesis, inorganic nutrient absorption and the other metabolic activities of the growing plant A cutting, on the other hand, is a vegetative organ, not characterized by the storage of nutritive and growth substances to the extent observed in the seed. Cuttings of different species, or for that matter cuttings of the same species, taken under varying conditions may differ in vitamin B_1 content which in some cases may conceivably become a limiting factor in root development. Thus the beneficial effect of vitamin B_1 on the rooting of certain cuttings is not inconsistent with the finding that, when propagated from seed, green plants are capable of synthesizing their own vitamin B_1 requirements. In the light of the observation that in higher plants vitamin B_1 is synthesized in the green leaves under the influence of light[5] it is interesting to note that the presence of leaves on cuttings usually promotes root formation.[12]

This discussion is based on work done with several species of plants grown under favorable nutrient and climatic conditions. Whether under conditions adverse to the synthesis of vitamin B_1, these and other plants, even when grown from seed, may respond favorably to additions of vitamin B_1 from without, is a question of potential agricultural interest which can not be answered definitely at this time. Evidence was obtained, however, to show that several widely differing species, when grown from seed under favorable conditions, are not limited in their growth by an inherently low rate of vitamin B_1 synthesis.

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SOME DIFFICULTIES ENCOUNTERED IN THE EXTRACTION OF GROWTH HORMONES FROM PLANT TISSUES[1]

ALTHOUGH there are nearly as many methods of extracting plant growth hormones (auxin) as there are investigators, there is no satisfactory quantitative method. For over two years the author has been engaged in studying growth hormones in a number of plants, and during that time he has tried out many of the existing methods. Van Overbeek's[2] method has been used as the standard against which the others have been compared. It has proven to be as satisfactory as any, but it does not extract the auxin quantitatively from the material under investigation. The trouble has been that only after weeks or months of extraction was a point reached where no more auxin was obtained from the material.

The auxin assay has been carried out in the usual way with *Avena* coleoptiles under standard conditions of humidity and temperature and calculations made according to the equation formulated by Van Overbeek. In his publication of the method, Van Overbeek stated that he obtained complete auxin extraction in a period of 24 hours, and that succeeding periods gave no further active material. The writer has not found this to be true with his material, even when the extraction was done on an agitator, as shown in Table I.

TABLE I

AUXIN CONTENT IN OVARIES OF THE SUNFLOWER. THE AUXIN CONCENTRATION IS DENOTED IN TERMS OF INDOLE ACETIC ACID EQUIVALENTS, AND THE FIGURES ARE GAMMAS PER KG OF FRESH MATERIAL

Extraction	Time of extraction in hours	Amount of auxin obtained H_1	Amount of auxin obtained H_2
1	37	0.6	2.22
2	25	1.74	1.46
3	26	0.81	0.97
4	27	0.70	0.77
5	37	1.04	1.81
6	45	1.21	1.63
7	27	1.17	0.75
8	24	1.35	0.44
9	20	0.74	0.99
10	22	0.85	0.98
11	23	0.41	1.22

Note: During the next two weeks several more extractions were made and each showed the presence of auxin.

Table II gives the data from an experiment with young tomato plants.

These two experiments are typical of the many that have been performed during the past two years. It is obvious that not all the auxin, which is finally extracted

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[11] F. W. Went, J. Bonner and G. C. Warner, SCIENCE, 87: 170, 1938.

[12] Review by H. L. Pearse, Imp. Bur. Hort. and Plantation Crops, Tech. Com. 12, 1939.

[1] This investigation has been financially aided by the Horace H. Rackham Trust Fund of the University of Michigan.

[2] J. Van Overbeek, *Proc. Nat. Acad. Sci.*, 24: 42–46. 1938.

TABLE II

Auxin Content in Tomato Seedlings. The Auxin Concentration is Denoted in Terms of Indole Acetic Acid Equivalents, and the Figures are Gammas Per KG Fresh Material

Time of extraction	Conc. of auxin	Time of extraction	Conc. of auxin
1939–			
4–10	3.98	8–27	1.70
	*1.06	9–18	9.55
	*1.82	25	1.07
15	1.87	10– 3	0.60
22	2.27	7	1.09
29	0.97	14	0.96
5– 4	1.00	24	0.70
11	0.91	11– 4	1.30
21	1.07	18	1.95
25	0.78	21	1.91
30	1.30	28	0.5
6– 5	1.31	12– 8	1.54
7	1.12	15	0.74
15	1.03	1940–	
7–13	0.68	1– 5	0.93
15	1.36	16	1.47
19	1.21	27	1.9
21	1.20	2–10	1.33
24	1.50	20	1.24
27	1.50	27	1.76
31	0.96	3– 9	2.39
8– 4	1.17	23	2.50
9	2.29	4– 8	2.50
14	†1.62	5– 6	3.66
17	1.58		

* Refluxed 4½ and 3 hours, respectively.
† Material frozen and ground finely.

from a lot of plants, was there in an active form at the time the plants were collected.

DuBuy's[3] method of extracting the frozen and ground plant material with cold water has not been found to be satisfactory. Avery's[4] recently published method of extracting with alcohol, while satisfactory with dried corn, does not work with fresh plants. Thimann[5] used chloroform as a solvent, and in an experiment with *Malvaviscus* sp. it has been compared with ether. The total auxin obtained in 14 extractions was nearly twice as great with ether as with chloroform.

Table III shows the importance of proper dilution.

TABLE III

Influence of Dilution upon the Apparent Amount of Auxin Obtained. The Auxin Concentration is Denoted in Terms of Indole Acetic Acid Equivalents, and the Figures are Gammas Per KG of Fresh Material. The Amount of Material was the Same in All Determinations

Amount of agar in cc added to the extract				
.6	.7	1.0	1.5	2.0
2.00		3.64	5.06	
3.20		3.84	7.65	
	3.38	4.10	6.32	6.28
2.49		3.72	6.07	5.94

Of the solvents used ether seems to be the best, but it does not extract all the auxin except after many extractions. Care must be taken to have proper dilutions. This has previously been discussed by Went and Thimann with respect to indole acetic acid but not previously stressed with extracted material.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE METHOD OF OBTAINING PURE CULTURES OF EMBRYONIC HEART MUSCLE

A brief statement concerning the cultivation of embryonic chick heart muscle *in vitro* may serve a twofold purpose, adding to the data available on the tolerance of tissue cells from warm-blooded animals to subnormal temperatures[1] and suggesting a possible method of obtaining pure cultures of embryonic heart muscle.

Fragments of 8-day embryonic chick heart muscle were explanted to a medium consisting of 1 drop of fowl plasma (dil. 2:1 with Tyrode solution) plus 2 drops of freshly prepared 8-day embryonic juice (dil. 1:2 with Tyrode solution). One culture of a limited series remained in the incubator continuously for a period of 18 days without renewal of the nutrient medium. The temperature during incubation varied between 33°–35° C.

Microscopic examination of the living culture on the eighteenth day of cultivation revealed a network of refractile cells which were contracting vigorously. The nuclei of the cells appeared unusually clear with particularly prominent nucleoli. Connective tissue cells had entirely disappeared from the culture.

Microscopic examination of the fixed and stained preparation (Champy-Kull process followed by Heidenhain's iron alum haematoxylin method) showed that histodifferentiation had not taken place. No striated myofibrils were present in the network of cells. There was an accumulation of uniformly fine fat droplets in a relatively small number of cells, while a still smaller number contained large vacuoles. The nuclei of the vacuolated cells showed evidence of degenerative changes. No mitotic figures were present.

The fact that the muscle cells remained functional while all types of connective tissue cells degenerated suggests a simple method of obtaining pure cultures of embryonic chick heart muscle. The more usual method of subdividing cultures at the time of transplantation is worthless in the case of heart muscle, since disturbance of tensional stresses set up within the culture leads to the eventual degeneration of the muscle cells.[2]

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[3] H. G. DuBuy, *Jour. Agr. Res.*, 56: 155–158. 1938.

[4] G. S. Avery, *Am. Jour. Bot.*, 26: 679–682. 1939.

[1] A. Fischer, *Arch. f. exper. Zellforsch.*, Bd. 2, S. 303–305, 1925–26; L. Buccianti, *ibid.*, Bd. 11, S. 397–423, 1931; E. F. Stilwell, *ibid.*, Bd. 21, S. 447–476, 1938; D. C. Hetherington and J. C. Craig, *Jour. of Cell. and Comp. Phys.*, 14: 197–203, 1939.

[5] K. V. Thimann, *Jour. Gen. Physiol.*, 18: 23–34. 1934.

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EVALUATION OF ISOBUTYL METHACRYLATE POLYMER AS A MOUNTING MEDIUM

APPARENTLY on the strength of the recent article by O'Brien and Hance[1] regarding the use of isobutyl methacrylate polymer as a mounting medium for covering histological sections, a scientific instrument and supply company has stocked the material and has recommended it in the house organ of the company. Inasmuch as the article of O'Brien and Hance is misleading, I should like to refute their claims to the end that many microscopists might be spared disappointment.

A year and a half ago I acquired some isobutyl methacrylate monomer. Shortly thereafter I found that the polymerized material is not satisfactory as a mounting medium either with or without a cover glass. It does not adhere as well to glass as do the other resins used. This is, admittedly, of slight import if the slides are handled with ordinary care. Certain stains are faded rapidly by it. It softens and decomposes at relatively low temperatures. Hence slides covered with it can not be used in a carbon arc projector unless precautions which restrict the usefulness of the projector are taken to keep the point at which light is directed from getting hot.

The fourth, and major, objection to isobutyl methacrylate polymer is the fact that its refractive index, 1.477, is much lower than that of any of the tissue elements which remain in an ordinary animal tissue section prepared for histological work. For example, the refractive index of unstained striated muscle after being treated as in ordinary histological procedure is 1.537 ± 0.003. The refractive index of stained tissue is still higher than that of unstained tissue. The relatively great difference between the refractive indices of tissues (mainly denatured proteins) and isobutyl methacrylate polymer accounts for the observation of O'Brien and Hance that their preparations were "somewhat more brilliant when viewed under the microscope than are specimens mounted in Clarite." The brilliancy is simply the general effect of the Becke line,[2] which is undesirable, at least for most microscopical work including photomicrography. Inasmuch as the concentration of the stain in the tissue is low, the dispersion curve, refractive index (n) plotted against wave-length (λ), will be nearly regular. The ideal medium for stained sections would be one for which the dispersion curve, n plotted against λ, is the same as the dispersion curve for the stained tissue. The stained tissue elements then would be opaque only because of their absorption of light of certain wavelengths. This ideal medium can not be realized because the different tissue elements of the section do not have the same dispersion curves, and indeed the same elements of a given section may vary slightly among themselves. For practical purposes, a mounting medium should be used which has a refractive index for the D line of the spectrum as close as possible to that of most of the stained tissue elements.

From the point of view of refractive index alone, Clarite X is the best mounting medium on the market for critical work with animal tissues. Its refractive index is 1.567. This is very slightly lower than that of most stained elements, but is appreciably closer than any other medium available. Also, if there are any unstained or faintly stained elements in the section they are less apt to be missed with Clarite X than with Clarite, gum damar or Canada Balsam inasmuch as the refractive indices of the latter three are much closer to the refractive index of unstained tissue elements than is Clarite X. Clarite has an index of 1.544. Sections mounted in it can be distinguished readily from those in Clarite X upon examination under the microscope. The refractive index of gum damar is 1.542. That of Canada Balsam is still lower, 1.535. The refractive index of isobutyl methacrylate polymer, 1.477, is quite low in comparison to the above, and makes the material of little use as a mounting medium except possibly in special cases where a very low refractive index is desired.

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[2] C. M. Goss, *Arch. f. exper. Zellforsch.*, Bd. 12, S. 233–248, 1932; E. F. Stilwell, *ibid.*, Bd. 21, S. 447–476, 1938.

[1] H. C. O'Brien and R. T. Hance, SCIENCE, 91: 412, 1940.

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REACTIONS PRODUCED BY NEUTRONS IN HEAVY ELEMENTS[1]

By Dr. ENRICO FERMI

PROFESSOR OF PHYSICS, COLUMBIA UNIVERSITY

THE nuclear reactions produced by neutron bombardment in heavy elements can be conveniently described, according to Bohr, with the assumption that, as soon as the bombarding neutron strikes the nucleus, it is incorporated into the nuclear structure with the formation of the so-called compound nucleus. This is a relatively stable system in the sense that its lifetime is very long compared with the frequencies of nuclear particles; in an absolute sense, however, the lifetime is very short, being sometimes of the order of 10^{-12} seconds and sometimes much less.

The ultimate result of the nuclear reaction depends upon the way in which the compound nucleus further disintegrates. And this mode of further disintegration depends in its turn, for any given nucleus, essentially upon the energy content of the compound nucleus. When the bombarding neutrons are slow the energy of the compound nucleus is equal to the binding energy of the neutron in the nucleus. Apart from irregular fluctuations from nucleus to nucleus, this binding energy has a general variation with the atomic number and is a maximum for elements of atomic weight about 40 where it is in the average about 9 Mev. From there on it decreases more or less regularly up to the heaviest elements where it attains an average value of about 5 Mev. If the bombarding neutrons are fast, their kinetic energy must be added to the binding energy to obtain the total excitation energy of the compound nucleus.

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[1] Presented in a symposium on "Nuclear Physics," at the University of Pennsylvania Bicentennial Conference, September 19.

The compound nucleus can loose its excitation energy by emission of some particle (neutron, proton, alpha particle or photon) or, in the case of the heaviest elements, thorium, protoactinium and uranium, it may disintegrate by fission into two approximately equal parts. Apart from this latter case, the most probable processes for medium weight and heavy elements is the emission of photons and of neutrons. Emission of protons and of alpha particles requires a much greater energy on account of the Gamow barrier of potential that the particle must overcome before coming out of the nucleus. Furthermore, in a nucleus containing one hundred or more particles, even when this energy is available, it is unlikely that it should all be concentrated in one single alpha particle or proton in order to give to it a sufficient energy to escape from the nucleus. It is much more probable that a neutron should be emitted instead, since a much lower concentration of energy is sufficient in this case.

The relative probability of the emission of a photon or of a neutron depends mainly on the energy. When the energy is barely larger than the binding energy of the neutron, as in the case of bombardment with slow neutrons, a photon is usually emitted. If instead the energy of the compound nucleus exceeds by a considerable amount the binding energy of the neutron, as in the case of bombardment with fast neutrons, the emission of a neutron from the compound nucleus becomes the most probable process. Even when the excess of energy is very large it is improbable that the outcoming neutron carries away all the energy that is available; indeed one can expect theoretically that the escaping neutron has a small probability to come out with an energy in excess of 2 Mev. In most cases, therefore, the nucleus remaining after one neutron has been emitted by the compound nucleus will still be in an excited state. The emission of one or more photons or, when the residual excitation energy is sufficient, of a second neutron ((n,2n)-reaction) will then occur before the nucleus reaches a stable configuration.

Compound nuclei of the very heaviest elements may also disintegrate by fission. This form of disintegration is made possible by the large amount of energy released by splitting a heavy nucleus into two approximately equal parts. In this respect we may say that all heavy nuclei are unstable. Their practical stability is, however, insured by the fact that the two fission fragments must overcome a practically impassable Gamow barrier for separating. In the case of uranium and thorium the height of this barrier is not so large any more and what prevents spontaneous fission is probably the large mass of the fission fragments which gives a very low penetrability even to a barrier which is not very high. The relatively low excitation due to the arrival of a neutron is sufficient in these cases to excite the compound nucleus in a state above the top of the potential barrier or so near the top that the fission process becomes possible. It should be noticed in this respect that the bare extension of the Gamow mechanism of the potential barrier is probably not the only one that is responsible for the high stability of uranium with respect to the fission process: probably also other factors, as, *e.g.*, the low probability that the nucleus should take such a configuration as to make possible the transition into two fragments, play an important role in ensuring this stability.

It follows from this discussion that the most probable types of nuclear reactions in heavy elements under neutron bombardment are the following:

(n, γ), produced especially by slow neutrons.
$(n, 2n)$, produced only by very fast neutrons.
Fission produced only in the heaviest elements by fast and, in one case, also by slow neutrons.

Uranium is a typical example of this behavior because in this element all three types of reactions are observed. The (n, γ) reaction was discovered by Hahn and Meitner, who recognized that among the active products produced in uranium by neutron bombardment one, with a period of 23 minutes, produced by a typical resonance process, is carried by an isotope of uranium. The assignment of the atomic weight of this isotope as 239 has been confirmed by direct experiment by Nier, Booth, Dunning and Grosse. U 239 disintegrates into an isotope of element 93, which is also radioactive with a period of 2.3 days as proved by the investigation of Abelson and McMillan. When uranium is bombarded with very high energy neutrons an (n, 2n)-reaction may take place whose final result is the formation of an isotope 237 from the main isotope 238 of uranium. This nuclear reaction has been recently reported by Nishina and others by McMillan; they found for this isotope a period of 7 days. The most interesting reaction produced by neutrons in uranium is the fission process, which occurs both in the isotope 238 and in the rarer isotope 235.

Since the fission process has been the object of many discussions I shall limit myself to the consideration of only one aspect of this phenomenon. The chemical investigation of the radioactive products of fission has proved the existence of a very large number of radio-elements indicating that the fission can occur in a number of different ways. We are thus led to the conclusion that after the compound nucleus is formed by adding a neutron to uranium the actual splitting of the nucleus may lead to different pairs of fragments; each one of them gives rise to a chain of radioactive elements having in the average 3 or 4 elements. It has been early recognized that the simple theory of the fission process fails to represent correctly the results in so far as the splitting does not occur into two equal fragments but rather into fragments in which one is somewhat lighter and one is somewhat heavier. We have therefore to distinguish between a light and a heavy group of fragments. Presumably a fragment belonging to the light group and a fragment belonging to the heavy group are emitted in the same act. The problem arises now to determine what percentage of the fissions of uranium gives rise to the formation of a certain radioactive product or rather of a certain radioactive chain. Since it is expected that in every fission a chain belonging to the heavier group and a chain belonging to the lighter group are formed we would expect a total percentage of 100 per cent. for each of the two groups, except for the improbable direct formation of a stable fission fragment. Since very little quantitative information is available as to the relative intensities of the various fission products, Anderson, Grosse and I undertook last spring a systematic investigation of this problem. Our purpose was to make a preliminary survey, and the results obtained so far cover most of the known radio-elements of the heavy group. The method used consisted in comparing the intensities of various radioactive products obtained by chemical separations from uranium samples irradiated under standard conditions and for a known length of time with the Columbia cyclotron. A known fraction of each radio-element was separated and brought near a counter; the activity was deduced from the number of counts, corrected in order to take into account the absorption by the counter walls and the various geometrical factors. We have thus been able to assign the percentage of fissions of most of the chains of reactions belonging to the heavy group. They vary from a minimum of about .1 per cent. to a maximum somewhat over 10 per cent. The percentages found so far for the heavy group do not add to a sum of 100 per cent. but rather to about one half of that. Apart from experimental errors, which can be quite considerable in measurements of this kind, this fact is probably due to the incomplete chemical investigation of this group. They indicate that probably some more radioactive elements of the heavy group, possibly belonging to the rare earths, have yet to be discovered and analyzed.

MENTAL HEALTH[1]

By Dr. ADOLF MEYER

THE JOHNS HOPKINS HOSPITAL

THE symposium on Mental Health before the American Association for the Advancement of Science, December, 1938, is a document of considerable interest and importance to a wide range of students, workers and organizers.

It is brought before us by the original organizer of the program, Walter L. Treadway, assistant surgeon-general in the Department of Public Health, assisted by Nolan D. C. Lewis, director of the New York Psychiatric Institute—connected with the Columbia University Medical Center; Abraham Myerson, the head of a research group in the Boston State Hospital; a statistician in this domain in the person of Joseph Zubin, of the New York Psychiatric Institute; Harry Stack Sullivan, for years active in bringing anthropology and the study of personality together under a lead of psychiatry; Clarence M. Hincks, then the head of both the United States and the Canadian National Committees for Mental Hygiene, and Franklin G. Ebaugh, who has done so much for the organization of psychiatric education, in charge of the pertinent division of the National Committee, and head of the psychiatric department of the Colorado University Medical School and Hospital.

The chairman, Dr. Treadway, had devoted several months almost exclusively to preparation for this contribution to a great public health problem in order to make the undertaking a model of its kind. The result presents mental health—as a major public health problem, as a major issue for American scientists, as a vital concern of society—in a symposium as carrier of a broad orientation properly belonging before the forum of all the sciences.

The symposium is presented in eight main chapters, but actually in six special sessions of Section N of the congress, the last chapter, under the title of "Human Needs and Social Resources," being presented to the whole congress as the final address by a leading psychiatrist, Dr. C. Macfie Campbell, of Harvard.

The first chapter, to judge by its title, was no doubt intended, and was certainly wanted, as a preliminary orientation and perspective as regards facts and terms. Evidently, through an act of courtesy and conformity with the organization of the association, the year's chairman of the Section of Medical Sciences was invited to offer this orientation, and he offered a brief introduction, in the form of "remarks . . . not entirely my own, because the phraseology as well as the ideas have resulted from discussion with a number of people." He does not tell us who these co-responsible people are. Instead of offering a much-needed practical as well as theoretical orientation which would have had to bring together the "natural" and all the other (humanistic and formal linguistic-semantic and historical) sciences which belong in the American Association to be addressed, and which also deal with the topic of man and his health, the "remarks on the aims and purpose of the Symposium" hardly touch the content of the book, but merely reiterate the still widely prevailing old complaints of "isolation of psychiatry," which should cease being "an island lying off the mainland of medicine," and become part of the medicine he knows. In the place of a mere "inundation of words," still (?) obscured by such traditional abstractions as "mind and body," and the inveterate tendency to think that to be scientific one has to reduce specific sets of facts into "something else" before they are first made clear enough among themselves, psychiatry should yield "dry ground of observation, hypothesis and verifiable experiment" so as to connect the traditionally "isolated facts of mental function and mental disease with the more continental accumulations of physics, chemistry, physiology and pathology"—apparently questioning any necessary recognition of a specific status and role and methods of the mentally integrated data. ". . . the general tenets of science and the common rigors of scientific thought must be asked of the psychiatrist as well as of other clinicians." The advice that the topic should no longer be allowed to be treated "in an illogical or arbitrary manner" might have been reciprocal and properly addressed to both "the mainland" and "the island," when the introducer presented the praiseworthy injunction that we should from time to time re-examine the realities "with freshness, humility and understanding"—only to do glaringly otherwise. He does not seem to realize that in his simile of "mainland" and "island" it may be his "mainland of medicine" in general that is at least as responsible for the *mutual* "isolation" as the too often neglected "island" itself. If he does not see this, he gives a most deplorable example of blind-spot. Instead of bringing the "natural" and the "humanistic" sciences together into one common formulation of life and dynamics and motivation, with room for the settings also for the mentally integrated and differentiated parts or factors in the events, he speaks in terms of "psychological concomitants" and psychosomatics, harking back to parallelism. And while he urges the acceptance of the "patient that is," he leaves the real task in the hands of the "internist," experienced in nervous and mental disease and willing to consult also the psychiatrist. For his missionary spirit of exhortation he marks as his target the "timid incompetent physician" and "the bold incompetents" in the asylums. The best he can do or cares to do with his exhortation is to select the internist instead of the "psychiatrist" as the basic and sole director of the field—leaving one wondering whether he confuses the psychiatrist, who certainly has to be a well-trained physician, with a psychoanalyst, who might indeed keep aloof but to-day is increasingly less inclined to do so. The reader looks in vain for an orientation of the present-day status of a science of man-function and of mental health or ill health with a real understanding of psychiatry and of psychology. What he finds quoted as samples is a caricature, and the warning that the terms are often "misused" to mean a "working knowledge of human nature," fits together with the cryptic characterization in the reference to the "hundreds of thousands of patients whose physical preservation only emphasizes their mental deterioration." With a fair and constructive discussion of the facts and the situation, a great gain in factual and logical orientation might have come to both "mainland" and "island," through a sound and much-needed working together of all that is pertinent and also free of the obsession that understanding should be a reduction of everything to something different from what it is, and more like one's own beloved continent.

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[1] Publication of the American Association for the Advancement of Science, No. 9. Edited by Forest Ray Moulton and Paul O. Komora. 470 pp. Lancaster, Pa.: The Science Press. 1939. $3.00.

Instead of a friendly inquiring visit to the territories treated as an island, or perhaps rather as an archipelago—seeking out the places of work closest to what his ideal reached for—he gives us a nightmare and a curtain lecture of largely non-pertinent reiterations of unfortunately still wide-spread complaints about mere inundations of words, impressions of private dialects and neologisms in a one sidedly dismal picture:

> "Let us admit that state hospitals for mental diseases have harbored in service many a timid incompetent physician, but familiarity with bold incompetents elsewhere in the practice of medicine makes modesty rather more attractive than otherwise. To be just, however, we should recall that the field of psychiatry has also harbored physicians big enough to live their lives in frustration of their hope to find some way of easing the increasing load of mental disability or disease. It is such men who merit the interest, understanding, help and cooperation of the rest of the medical profession."

This is all very painful, and obviously largely quoted at a distance without any evidence of familiarity. Like so many specialists full of the universal dominance and ultimate explanatory power of the more and more about less and less, and missing their stand-bys of "gas exchange or water balance" in the attempts to relate such phenomena observed in the insane to known facts in other fields of medicine rather than other "personal terminologies," he wants to build out exclusively "from the mainland of medicine." Wherein does the speaker see not only the importance but the sense and nature of psychology and psychiatry? He wants to bet on the salvation by the internist. He wants him to be "a highly trained internist, with interest and experience (where obtained?) in nervous and mental disease, not only permitted but urged, to elicit aid from as many sciences as appropriate: for example, physiology, chemistry, psychology, and psychiatry." Again I ask: Where obtained or found and cultivated, and how? The introducer displays a vicious circle of distrust derived from unfamiliarity and lack of curiosity as to what is actually being done—a sorry exhibition of the neighbors considering themselves the mainland. All he finally sees is that "it may be the great contribution of psychiatry in the future to describe and define the 'art' of medicine in more precise and useful terms by *insisting upon the comprehension of the physician* as one of the factors in the prevention and cure of disease." And what is the "comprehension"? What is to him the field and work of psychiatry and psychology if he does not allow it to aim for "a better working knowledge of human nature"? One might wish that one might at least and at last get closer to that; we might not have to run into the cryptic pessimism of this picture of the present "hospital beds filled to overflowing with hundreds of thousands of patients whose physical preservation only emphasizes their mental deterioration" and into "it is high time that the psychiatric problems such persons present be attacked in a fundamental manner with all our faculties for observation and facilities for investigation." He fails to say to what extent and how his internist will include and integrate the "mentally integrated facts" in his "internal medicine."

In the absence of a positive and real orientation on factual responsibilities and activities in the special field expected from the temporary chairman of Section N (Medical Sciences), the planned symposium begins abruptly with Chapter II, as "Orientation and Methods in Psychiatric Research" (pp. 9–66): Epidemiology, facilities for research in state hospitals, the structural and physico-chemical alterations of the central nervous system, convulsive disorders as a field of research, the field of clinical research on abnormal behavior in infancy, childhood delinquency, biometric methodology, the clinician's summary, the psychologist's view of fundamental and applied research, and the need of integrating the research forces of the country to secure support—each of these topics is treated by a competent special worker, and the group reviewed by prepared discussions and discussions from the floor.

The second session or section (Chapter III) deals with "Sources of Mental Diseases and Their Amelioration and Prevention" (pp. 71–145), but is limited to genetics, syphilis, alcohol, vitamins, fatigue, birth control, child caring, immigration—with noticeable omission of the "mentally integrated" or psychogenic dynamics and processes.

There follows "The Economic Aspects of Mental Health" (pp. 149–234): magnitude of the problem, economic loss, cost, family care, social security, the bearing of the emotional factors and economic disability and an especially replete review which contains much new material. The fourth session, on "Physical and Cultural Environment in Relation to the Conservation of Mental Health," deals with psychiatric and cultural pitfalls as seen by the anthropologist, and some comparative ethnological data on culture and personality, community differences, selective internal migration, segregated communities, integrative politics and communication of ideas (pp. 237–287)—actually contributions largely from non-medical collaborators, bringing in problems and view-points showing clearly the need of reciprocity between the specialized collateral disciplines of the science of man rather than what the worker in practical psychiatry comes to focus on. The next chapter, again from a very different angle, *viz.*, that of "Mental Health Administration," presents centralized state organization, state supervision of the feebleminded, qualification of personnel, the practices dealing with admission to hospitals, psychiatric expert testimony, *bona-fide* residence and fiscal responsibility, meeting the needs of the patient during the first year of residence in a mental hospital, role of the mental hospital and provisions in a community, local health departments and statistics, the sociological aspect of mental health administration and the function of government (pp. 291–370). There follows as the last section an extensive detailed consideration of "Professional and Technical Education (of personnel) in Relation to Mental Health" (the specialists, undergraduate training, administrators, psychologists and specialists, nursing and the public health nurse, occupational therapy and social workers, relation to internal medicine, role of the clergy and choosing the medical student (437–454). Each of these items or topics is presented by a leading worker. The conclusion of the whole symposium consists, as stated above, in a public address to the whole congress, giving a comprehensive picture—from the life of a worker who has to face a very wide range of psychiatric problems and teaching and investigation—of "Human Needs and Social Resources," by C. Macfie Campbell (pp. 454–470).

It is an immense program of discussions of activity and organization, but relatively little about the specific and particular relation of the sciences among themselves and to the patient and his problems, and to the scientists and the public and the kind of facts to be met. One might have asked: To what extent are the American Association for the Advancement of Science as a group and the special medical section so oriented as to meet man as a person for a basis of discussion of mental health? What is the status of science to meet this task? What do we mean by "mental" and how is it "worked"? What does the psychiatrically intelligent worker and public see in the field and in the concepts and methods? If it were not for the fact that there is much unnecessary but disturbing misconception concerning the problem, the "search" and the "research" might be much more effectively presented and pursued.

An attempt to characterize, and even more an attempt to summarize, the amount of material brought together in the forty-nine basic contributions and twenty-eight prepared and free discussions goes beyond the possibilities of a review. It is not so much any amazing amount of information that makes up the value of this symposium, nor largely the startling vision or glimpse into the monetary estimate of nearly a billion dollars loss in the United States of America per year through disorder of mental health, but it is rather the solid, descriptive and dependable factual material of the health problem that counts. A number of the basic papers, such as those on alcohol, child behavior and care, the summary of methods, the genetic discussion, and especially the economic studies, are quite outstanding; so are the discussions on administration and training of personnel and the relation among the specialties—never before brought together in such interrelation. The actual question of how one might get next to the crises and needs of the *patient* and the avenues of understanding and treatment and prevention—although perhaps not so clearly or specifically "public health and care issues," as public health is defined to-day—should nevertheless be vital also for any administration of the actual campaigns for progress. The division on "environment" is widening the horizon far beyond "public health" in the limited technical sense of the word; as such it proves probably more helpful to the studies in ethnology and population and sociological considerations than to those of the *strictly* medical sphere of modification of the costly results of the accumulation of invalids, and the studies of the elements and factors that contribute to the instability and unsettling of the equilibrium between the senseless and intemperate utilization of ever new implements and inventions, and on the other hand the lag of corresponding brain and character and intelligence development or even the simpler and more accessible possibility of making the public and the non-specialistic professions (including the rank and file of physicians) "psychiatrically and humanly more intelligent" and informed and the schools and universities more adequately attentive to the features of culture that should make for mental health and man's nature and self-regulation, and capacity to develop sound leadership.

The actual symposium appears to turn much more on the management of the various functions around psychiatry than on the specific material and the concepts and methods of mental health—good, bad and indifferent—but at least open to a more positive sense and direction. What will give us the sense and respect for the cultivation of psychiatric intelligence and a cultivation and sharing and application of psychiatric experience?

The first group of presentations offered is not an orientation on common ground, but starts at once with research, perhaps too much with the glamor of desired progress rather than a substantial presentation of the actual work and the types of familiarity and preparedness required to meet the actual problems with a balanced division of labor and a well-grounded reaching out in the field of mental health. One comes to feel that "research" is too much discussed as a matter of mobilization of the time and money of special types of workers and privilege free of the responsibilities of the work with the necessities rather than as a basic organization of the actual search and work and spending, and a selection of workers from the ranks and consultants familiar with special needs and settings that will give validity to and respect for the real work and material, made fit also for the elaboration and promotion of opportunities for the solution of problems. This is too often expected from the hands of persons unfamiliar with the burdens of direct responsibility and routine, but largely longing for special privilege in the use of time and apparatus and investigative machinery and techniques oftener borrowed than invested by and from direct experience. Without a group of presentations of the actually prevailing "too much or too little" of divisions of labor and fields of operation, one gets an impression of "approaches from the outside" in the different chapters and an underrating of the basic tasks and services actually practiced and the conditions to be met. Besides adventure we have to look to the cultivation of, and the rising from, the ranks and a correspondingly intelligent drawing in of the special talents and cultivation of tasks and centers and ramifications that bring up the centralization as well as decentralization, and intimacy as well as formal management and orientation of the work. Do theory and practice recruit themselves out of the actual work or out of more or less artificial implantations with a sound field also for hunches? We want basic training but not an uncritical spirit of introduction by one in no special way familiar with the problem and showing in himself the deliberate "continental" isolation of many leaders of medicine charging psychiatry with isolation. In the form taken by the chapter on the "Sources of Mental Disease and Their Amelioration and Prevention," one misses the core from which one might expect the warmth of contact and the bearing of all the qualities of the factors.

This holds also very largely for the fourth section in the quantification problem of statistics occupied largely with the demonstration of the immensity and distribution of the problem with too great a distance between the statistician and the worker furnishing his experience in fragmented data. The "physical" and "cultural" environment in relation to the conservation of mental health proves itself to have been treated almost exclusively by non-medical specialists—except in the discussion—with interesting perspectives but rather lacking in that immediacy of contact with the workers and the issues of the actual field of work dealing with our own particular civilization and organization. The existing desire for international and interracial and ethnological statistics does not go with commensurate similarity or consistency of workmanship. The mental health administration comes closer to the actual issues but is rather too separately towering over the workers; and the professional and technical education in relation to mental health deals more with new and often better divisions of labor than the conditions for better actual centers and better distribution of work and the personnel.

The upshot of the "symposium" might well be judged in the light of its contribution to "person-function" or ergasia, and the corresponding energizing and orientation on the part of the workers, producers and consumers, and the general picture of the living and working together of the concerns of this domain of "mental health." The best way to honor and use the volume of "Mental Health" will be that of frequent reference to the groups of papers pertaining to emergencies of practice and research; and the utilization also of the literature references. It would, however, mean a great deal to have an *index* of topics and workers and places worked in, perhaps in connection with a follow-up every three or five years giving the accessible summaries and perspectives and evaluations to many of the special statements.

When we make the public and the scientists mind-conscious, we also have to furnish better knowledge of where "mind-work" is found in specific forms in operation, open to constructive inquiry and participation—no doubt including a psychology and psychiatry based on a solid and comprehensive science of man as person and groups of persons, as well as of parts, in the successive phases of development and the origins and goals in settings in contact with life. Next would come the question of ways and means, and practical management and the organization of the workers and the work, and a knowledge of where to go to find the information and help actually at work in demonstrative samples of performance.

What strikes me in so many of the discussions is the strange or foreign remoteness of the considerations from where and in whom and wherein the actual problems take place. Where and when do the things happen that call for attention? Where does one go to meet the facts as they are? Because of the lack of an introduction written by a competent psychiatrist instead of a rehearser of anachronistic tradition, one has a feeling as if most of the matters discussed were mainly concerns of the administrator, the investigator and experimenter and as if the patient were largely "the victim" and a kind of host of the trouble, and not a *participant* and center of the difficulty itself and the live entity to be guided as well as helped and searched and researched and sampled and regulated—expected finally to regulate itself. This is where the concepts of what is called psychology and person-function show their fullest colors and specific modes of dynamics on which the amelioration and prevention in the end turn and depend and where the ergasiologist has to prove himself as not merely a good internist and sociologist, but really an expert in biotechnics and in biography in the making and in action. This is where the introducer would probably point his finger at special "words," forgetting that they are essentially signs pointing to one's having to turn to the facts and, even further, to what they stand for. It is perfectly true that we must expect of the psychiatrist sound medical training along all the specifically medicinal lines, but with just as much of a sound grasp on the "person and setting," situational and personal, psychobiological, physiological and sociological and biographic. For a great deal of "person-function" (*i.e.*, psychology as psychobiology, or, more modestly and objectively, "ergasiology," mentally integrated functioning, occupied with the working rather than with the substantialized soul or with mere physiology) the experience and use of sound critical common-sense counts for more than either the chemical or genetic or physiological detail or detachable exogenic factors such as alcohol and spirochaetes, or metabolism.

One has a right to say that any one not able to include in the physician's work and responsibility what one can learn from novels and life records should not be a physician,[2] but also that any one devoid of physiological and anatomical "at-homeness" should not pose as one with a well-rounded general education, or as a safe sample of general leadership.

The evolution of a disorder may have its soil in heredity and its immediate difficulties in the "daily" diet or regular régime in care of self, and the functioning and involvements of personality life. That is what the ergasiologist has to learn to command as his special concern: the description and singling out of specific findings and their correction and operation. But of all of it, relatively little is said and sought. We have our own specific concepts for the aggregate of events, and "psychology" includes the science of the way in which the functioning also deals with itself, as our mentation with its wealth of sign-function that works not only as a tool, but rises from our dialects or intimate and local means of interchange to our more widely comprehensive and intelligible conceptions in which we can transact our business and finally evolve the very science and critical thought and planning on which our conduct of life feeds and prospers. This part is essentially that of the representation of the sharable preparedness to muster what as individuals and groups we include in our nature in behalf of the regulations of "history in statu nascendi," the shaping of human fate.

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[2] See the conclusions from the "Symposium on Materials and Methods of Human Nature and Culture," *Am. Jour. Psychiatry*, 92: 355, 1935.

To do justice to the remarkable assemblage of the free expression of sixty-eight contributors would mean a huge task and deserve something more like a book than a review, but even better, a succession of reviews or symposia on the symposium.

The problem is of such vital and far-reaching importance that the American Association for the Advancement of Science would render a real service by appointing for a time a representative committee that would give a follow-up report from time to time aiming at digestion and the further development of appetite and orientation in the field: a committee on man's health as person and group—with a promotion of a psychology and a psychiatry and their foundations and bearings worth cultivating and consulting in behalf of the health of man and his civilization, not only as techniques and means of formal management but also its intrinsic logic and meaning. Out of that may arise a more widely permeating understanding of the interrelations in behalf of man of the sciences which the association brings together in its annual meetings. It would cultivate opportunities for the collateral sciences to help in the orientation among the actual workers rather than reiterations of the old prejudices used for false and ineffective self-excuse and perpetuation of reciprocal isolation.

The symposium deserves wide-spread attention and our gratitude to the organizers and contributors, and perhaps fully as much to those who challenge critical thought, as to those who give us the already available perspectives and the positive lifts and techniques.

OBITUARY

HANS ZINSSER

Bacteriologist, teacher, philosopher, author, poet, soldier

November 17, 1878—September 4, 1940

> He who is plentifully provided for from within needs but little from without.—*Goethe.*

HANS ZINSSER, Charles Wilder professor of bacteriology and immunology at the Harvard Medical School, died of lymphatic leukemia on September 4, 1940, at the Memorial Hospital for the Treatment of Cancer and Allied Diseases in New York City, where he had been a patient for the previous two weeks. During the summer he continued at work in his laboratories at the Harvard Medical School up to August 16, about the time of his departure for the hospital in New York.

By his death, the medical profession has lost one of its most brilliant and versatile personalities. It is difficult in a brief obituary notice fully to analyze and estimate his accomplishments, as he achieved success in many fields. He was internationally recognized as one of the most distinguished bacteriologists and scientific investigators of his age; he was acknowledged as an authority on medical education; he was an inspiring and dynamic teacher; he was generally conceded a leader in preventive medicine and in the direction of medical research. As an author, his great literary ability and originality have been universally recognized, and his last work, his autobiography, was selected as the "Book of the Month" for July.

Dr. Zinsser was born in New York on November 17, 1878, the son of August and Marie Theresia (Schmidt) Zinsser. In June, 1905, he married Ruby Handforth Kunz of New York. He is survived by his widow, a son and a daughter. The son, Hans H. Zinsser, is a second-year student at the Harvard Medical School and was married in June of this year to Anne Drinker, daughter of Dean Cecil Kent Drinker, of the Harvard School of Public Health. His daughter is the wife of Vernon Munroe, Jr., of New York City.

Dr. Zinsser was graduated from Columbia University with the degree of A.B. in 1899. He received the degree of M.A. from this university the same year that he received his M.D. from the College of Physicians and Surgeons (Columbia). After an internship at Roosevelt Hospital, N. Y. (1903–1905), he held bacteriological positions in New York at the Roosevelt Hospital (1905–1906); assistant pathologist, St. Luke's Hospital (1909–1910); and Columbia University (1905–1906, 1908–1910). In 1910 he went to California to become professor of bacteriology at Leland Stanford University, returning to Columbia in 1913 as professor of bacteriology and immunology, until 1923. He became professor of bacteriology and immunology at Harvard Medical School, Boston, in 1923, and Charles Wilder professor of bacteriology and immunology in 1935.

He received the honorary degree of doctor of science from Columbia University in 1929, Western Reserve

University in 1931, Lehigh in 1933, Harvard in 1939 and Yale in 1939. In conferring the honorary degree at Harvard, President Conant said of him: "A dynamic teacher whose vision extends beyond his laboratory; a famed investigator of the secret ways of man's microscopical enemies." At Yale, Professor William Lyon Phelps, conferring the degree, said in the course of his remarks: "He is one of the foremost laboratory scientists, and in the midst of his war against disease he has made friends everywhere in the world; his chronic courage is salted with humor; for although he is a medical philosopher, we may say of him what Edwards said to Johnson, 'cheerfulness is always breaking in.'"

He was a member of the American Red Cross Sanitary Commission to Serbia in 1915, and during the World War he served as Major and later as Colonel of the Medical Corps of the A.E.F., 1917–19. In 1923 he went to Russia as a sanitary commissioner for the Health Section of the League of Nations. In 1935 he was an exchange professor to France. He was awarded the Distinguished Service Medal of the United States, the Chevalier of the French Legion of Honor and the Serbian Order of St. Sava.

At the time of his death, in addition to holding the position of professor of bacteriology and immunology at Harvard, he was chief of the bacteriological services of the Children's and Infants' Hospital, consultant in bacteriology at the Peter Bent Brigham Hospital, and a trustee of the Massachusetts General Hospital.

He was a member of some 36 scientific societies, including the Association of American Physicians, American Academy of Arts and Sciences, National Academy of Sciences, American Academy of Tropical Medicine, American Association for Advancement of Science and the American Association of Immunologists (president, 1919).

In 1915 a great change came into his life, which obviously markedly influenced the later years of his work. As he himself wrote: "I felt I ought to get into the war in some capacity, and my chance came in March, when" there was "organized the Red Cross Typhus Commission for Serbia." Writing of his experiences at that time in regard to the Serbian epidemic, his "first experience of mass misery," while he refers to it as "as terrifying and tragic an episode as has occurred since the Middle Ages," his reminiscences of it (he says) are on the whole rather prosaic. Afterwards his great interest in the disease continued until the end. One sees this in the time and energy he devoted to his book, "Rats, Lice and History," which has been referred to as "the biography of a disease" and as a popular history of typhus. In the closing chapter of that book, he writes: "Not every one realizes that typhus has at least as just a reason to claim that it 'won the war' as any of the contending nations." It was well known to us in Serbia in 1915 from various sources that the Austrian and German armies were only waiting the subsidence of the typhus epidemic before crossing the Danube and invading the country, for the Allies had done nothing to reinforce the Serbian troops and prevent such an invasion of their country. In regard to this situation, Dr. Zinsser wrote:

> During all this time Serbia was practically helpless. Yet Austria did not attack. Austrian strategists knew better than to enter Serbia at this time. The probable results were obvious. Typhus—while scourging the Serbian popuatilon—was holding the border. The Central Powers lost six months during the most critical time of the war. It is anybody's guess as to the effect which this delay may have had on the early Russian and even on the Western campaigns. It is at least not unreasonable to believe that a quick thrust through Serbia at this time—with its reactions on Turkey, Bulgaria and Greece—the closing of Salonika, and the establishment of a Southwestern front against Russia might have tipped the balance in favor of the then very vigorous Central Powers. Typhus may not have won the war—but it certainly helped.

Dr. Zinsser's travels and studies, not only in Serbia but in Russia, Mexico and China, also especially enhanced his interest in the typhus group of fevers.

During the past ten years he had especially devoted his attention, and directed that of a number of his associates, to the problems of animal reservoirs, methods of transmission and immunization of the diseases of the typhus group, and has made some thirty-three original contributions, generally with his associates (especially Castenada) upon these subjects. As early as 1930, with some of his associates, he demonstrated that an active immunization against the murine or European varieties of typhus fever could be produced in animals with formalinized suspensions of the respective micro-organisms. In a paper published with Plotz and Enders in SCIENCE (January 12, 1940), which should be read in detail, various steps in the progress made by different investigators employing different methods for the mass production of typhus vaccine of the European type are outlined. The method finally recommended for securing large numbers of Rickettsiae consists of a combination of the agar tissue procedure of Zinsser, Wei and Fitzpatrick (1937), and of Cox (1938) of yolk sac culture, somewhat modified and employed as a source of inoculum.

At the time of publication of this last article, a number of daily newspapers wrote lengthy articles emphasizing the importance of the discovery. Dr. Zinsser, however, in an interview the following day, modestly deplored the publicity attendant upon the work, saying that it was merely a short step forward, based on the long and patient efforts of many people in different parts of the world.

His exceptional scientific attainments as an author have been well known to the medical profession for many years, not only by his individual contributions to journals, upon bacteriological research and the study of infectious diseases, but especially by his text-books. He has been a prolific writer of scientific articles since 1903, having contributed some 176 papers in the current journals. His "Text Book of Bacteriology," first published in 1910 and now in its eighth edition[1] presents in a clear and concise manner the fundamentals of bacteriology and immunology and the application of this knowledge to the understanding and control of infectious diseases; in addition, emphasizing the conception of medicine as a division of biological and social sciences in relation to other sciences. I do not know of a better text-book written on the subject, and it has proved almost indispensable, especially to physicians and students of bacteriology and preventive medicine.

His "Resistance to Infectious Disease" was published first in 1914 and was affectionately dedicated to his father, "A.Z." A second edition appeared in 1918, and a third in 1923. A third text-book, rewritten and now in its fifth edition under the title of "Immunity: Principles and Application in Medicine and Public Health"[2] constitutes a practical treatise upon the biological phenomena of infection and recovery of the animal body from infectious disease, with the consideration of the application of the principles of immunity to diagnosis, treatment and prophylaxis and their usefulness in the control of epidemics. This text-book has also proved of inestimable value to medical students, laboratory workers and students of public health.

Although his life has been an unusually busy one in active research and the direction of the work of others in his laboratory, as well as in teaching, the fact that these two text-books have been kept very fully up to date is another evidence of his great vitality, energy and capacity for hard work.

Dr. Zinsser was one of the principal participants in the symposium held at the Harvard Medical School of public Health on "Virus and Rickettsial Diseases" in June, 1939, and wrote not only the introduction to this volume, published in 1940, but also the two chapters on "The Immunology of Infections of Filtrable and Virus Agents" and "Epidemiology and Immunity in the Rickettsial Diseases."

Recently he had attained spectacular success as a writer in the authorship of two "best sellers"—"Rats, Lice and History" (1905) and his autobiography, "As I Remember Him; The Biography of RS," published during the present year.

This last book has been referred to as the conscious obituary of a man who knew he had but a comparatively short time to live, and in it he has described in the third person the pleasure and satisfaction he gained from various incidents as he approached death. He had been writing this book intermittently for some years, but had intensified his efforts since his return from China in June, 1938, when he and his physician recognized definite symptoms of lymphatic leukemia. However, instead of retiring to a life of leisure and rest, he continued his work in his laboratories and upon this book, with at times even more than his usual vigor. On occasions when stricken with weakness it was necessary for him to spend several days in a hospital and undergo x-ray treatment for the disease that was daily sapping his strength. After such treatment, when he had recovered somewhat from the shock of the treatment, the condition of his blood frequently became temporarily improved and he would return to his laboratory work. Such a life he led with full knowledge that he had only a comparatively short time to live. Courageously he continued to work and write, although anticipating his death. Only a few months ago, when a number of the chapters of his last book had appeared in the *Atlantic Monthly,* he spoke of these facts and then at the same time of the satisfaction he was still having in writing it. Such quiet, steadfast courage as he displayed in his daily life cannot be surpassed or forgotten. For, as he himself wrote of Francis Weld Peabody, "Courage is still, as it always has been, a thing of great beauty that springs, whatever its form of expression, from an inner source of moral power."

During the past summer, he drove his automobile from his home to his laboratories at the Harvard Medical School each day, pursuing his work, and in the evenings and on certain holidays saw his friends and lived the life of a man keenly interested in everyday affairs. When he went to New York to undergo another form of treatment a few weeks ago, while referring to it in a way as a vacation, he intimated to a very few that the treatment might be experimental and that he might not be able to return.

One of the earliest ambitions of Dr. Zinsser was apparently in the direction of literature. He has been a writer of verse for years, and during the past fifteen years has contributed twenty-four poems and sonnets to the *Atlantic Monthly.* His last sonnet from that magazine, published in 1940, reveals a depth and sweetness and tenderness that, alas, few of us had realized him to possess, and in it there is evidence of a mastery of form and feeling that marked him truly as a poet of great ability.

Morris Fishbein, editor of the *Journal* of the American Medical Association, in referring to "As I Remember Him," writes: "It is a medical biography to take its stand as a classic beside the Vallery-Radot "Life of Pasteur," the Paget "Sir Victor Horsley" and indeed even the Cushing "Life of Sir William Osler." It is as fine a contribution to autobiographic writing as I have known.

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[1] "Text Book of Bacteriology," by Hans Zinsser and Stanhope Bayne-Jones, Appleton-Century Company, 1939.

[2] By Zinsser, Enders and Fothergill, Macmillan Company, 1939.

Dr. Robert M. Green, associate professor of anatomy at Harvard, also writing of this book, asks: "Can any man be wholly known to his contemporaries? Oliver Wendell Holmes, autocrat, anatomist, and poet, wrote that each of us has at least three personalities: one as he is known to his maker, one as he is known to his fellow men, and one as he is known to himself. It is this third intrinsic personality of RS which Dr. Zinsser from long acquaintance and intimate documents has revealed. Out of an alembic mixture of recollection, personal confession and observation, he has recreated for us the real self of a man whom we have long admired and loved, but not fully appreciated."

Many of us are sensible of and in accord with this statement, and those of us who have been acquainted with Dr. Zinsser during the past few years recognize from his last writings not only elements of his character that we knew, but in addition other traits apparent, the existence of which we had not even realized or appreciated. For as he once wrote, as Carlyle says of Schiller, "the man's heart which few knew was as true and noble as his genius which all knew."

Dr. Zinsser, in his last chapter, in which the end of the life of RS is described, relates that during the last months his philosophy ripened and that he achieved a certain degree of philosophical tranquility, revealing something of the sweetness and the light of love in his soul. Although moving further away from faith in any comprehensible conception of God, yet he grew closer to the conviction of the wisdom and guiding integrity of the compassionate philosophy of Christ. He "felt increasingly grateful for the fact that death was coming to him with due warning, and gradually. So many times in his active life he had been near sudden death by accident, violence or acute disease; and always he had thought that rapid and unexpected extinction would be most merciful. But now he was thankful that he had time to compose his spirit and to spend a last year in affectionate and actually merry association with those dear to him. He set down this feeling in his last sonnet:

> Now is death merciful. He calls me hence
> Gently, with friendly soothing of my fears
> Of ugly age and feeble impotence
> And cruel disintegration of slow years.
> Nor does he leap upon me unaware
> Like some wild beast that hungers for its prey,
> But gives me kindly warning to prepare:
> Before I go, to kiss your tears away.
> How sweet the summer! And the autumn shone
> Late warmth within our hearts as in the sky,
> Ripening rich harvest that our love had sown
> How good that 'ere the winter comes, I die!
> Then, ageless, in your heart I'll come to rest
> Serene and proud, as when you loved me best.[3]

Dr. Zinsser lived a very full and unusually active life almost to the moment of his death, and the influence of his example and career will long continue. His deep faith in the power of honest scientific work to promote human welfare will long be a guiding light to others. His spirit will benefit humanity for many years to come, and no one who ever knew him will forget him.

RICHARD P. STRONG

SCIENTIFIC EVENTS

POLLUTION INVESTIGATIONS OF THE FISHERIES SERVICE

ACCORDING to *The Fisheries Service Bulletin*, Dr. M. M. Ellis, in charge of the service's pollution investigations in relation to aquatic life, reports that the field surveys carried out this summer have resulted in the collection of more material and more data than any previous trip. This success is attributed by Dr. Ellis, in part, to the use of new analytical methods and new physiological apparatus in the laboratory trucks from which the surveys were made.

During part of the month of July Dr. Ellis and his party visited the Black Hills region of South Dakota, where they cooperated with state officials in a study of gold-mine wastes in relation to stream conditions and fish life. A second problem investigated at the request of the state was the extent to which beaver dams modify stream conditions and water characteristics. Dr. Ellis reports that the beaver-dam problem in South Dakota appears to differ considerably from the situation in Michigan and other localities where these dams have been studied previously.

After collecting material related to the study of arsenic pollution at Gardiner, Mont., the field party proceeded to central Idaho for a study of irrigation waters from the Snake River, and thence to the Salmon River Valley to continue the studies of salmon spawning streams begun in previous years. Using Red Fish Lake in the Sawtooth Mountains as a base, the investigators were successful in securing much new data on these salmon spawning waters and also on waters frequented by the so-called redfish.

Mine-waste problems in the Coeur d'Alene region of Idaho engaged the attention of the field party for approximately ten days, after which it proceeded to Rock Island Dam on the Columbia River. Dr. Ellis has been following the changes in the water of the

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[3] Quotation by permission of the *Atlantic Monthly*.

Columbia and tributary streams since before the construction of the Grand Coulee Dam. These observations were greatly extended this summer, and in addition extensive physiological studies were made of the salmon and other fish passing through the Rock Island traps.

During the latter part of August studies were conducted of glacial waters near Mount Ranier and Mount Shasta, investigations which are closely related to the Sacramento River project and its effect on aquatic life.

THE MEDICOFILM SERVICE OF THE ARMY MEDICAL LIBRARY

According to a statement by the librarian of the Medical Corps of the U. S. Army, Colonel Harold W. Jones, under the authority of the Surgeon General of the Army, microfilm copying from the medical collections of the Army Medical Library has been conducted for nearly three years by Bibliofilm Service, a non-profit agency having its headquarters in the library of the U. S. Department of Agriculture. Although this service has rendered valuable aid to many research workers, it is believed that a microfilm copying service operating within the Library itself, and specializing in the field of medicine, will be able to contribute even more to the advancement of medical science.

The new service has been established through the generosity of a group of "Friends of the Army Medical Library." It has been given the designation "Medicofilm Service."

The service described will be conducted on a non-profit basis solely for making the extensive medical literature collections of the Army Medical Library available to research workers who are unable to come in person to consult them. The library cooperates by providing the necessary space for the work and by supplying the publications from which the microfilm copies are made. The only cost to the user is for the actual labor and materials required in making and distributing the microfilm copies.

The photographic copies on moving picture film of the separate articles in the periodicals are made at 30 cents for each complete article not exceeding 30 pages in length and 10 cents for each succeeding 10 pages or fraction thereof. A pamphlet describing the service and also containing the latest list of the approximately 4,000 medical and related periodicals currently received by this Library will be sent to those desiring to avail themselves of this service. In addition to medical periodicals the library also possesses an extensive collection of manuscripts and incunabula of which microfilm copies may be obtained. Requests should be made to: Microfilm Service, Army Medical Library, 7th St. and Independence Ave., S.W., Washington, D. C.

THE SEALING OF THE TIME CAPSULE

Ceremonies incident to the final sealing of the Time Capsule of the exhibit of the Westinghouse Electric and Manufacturing Company at the New York World's Fair took place at noon on September 23. The capsule was deposited in the ground outside the exhibit building before the fair was opened on September 23, 1938.

Harvey D. Gibson, chairman of the World's Fair of 1940, welcomed the gathering, and A. P. Craig, Westinghouse Exhibit director, presided. Dr. Clark Wissler, anthropologist of the American Museum of Natural History, and David S. Youngholm, vice-president of the Westinghouse Electric and Manufacturing Company, took part in the sealing of the capsule. Dr. Albert F. Blakeslee, president of the American Association for the Advancement of Science, made an address at a program "Youth Looks toward the Future," held in the afternoon under the auspices of the American Institute of the City of New York.

During the sealing-in ceremonies, 500 pounds of a special mixture of pitch, chlorinated diphenyl and mineral oil was poured around the capsule. This compound, because it resists electrolysis and is impervious to moisture, will provide a first line of defense against the destructive effects of time. It was developed by J. G. Ford as a seal for condenser bushings in circuit breakers.

The compound remains plastic over a 225 degree Fahrenheit temperature range, from 40 degrees below zero to 185 degrees above. This means that it will not crack open to enable the start of electrolysis. Its dielectric strength enables it to resist an electrical discharge up to 40,000 volts. It is one and one fifteenth times as dense as water, so that moisture can not penetrate to start corrosive action. It will adhere tightly to the metal for many hundreds of years through a wider variation in temperatures than that to which the capsule will be subjected. The capsule itself is made of cupaloy. This is an alloy of 99.4 per cent. copper, .5 per cent. chromium and .1 per cent. silver which can be hardened to the temper of mild steel but retains resistance to corrosion equal to pure copper.

David S. Youngholm, vice-president of the company, made a statement in which he said that more than forty articles used every day by people of the present are packed in the capsule.

Among them are a fountain pen and mechanical pencil, a watch, an electric lamp, a tobacco pouch with zipper, tobacco, pipe, cigarettes, cosmetics, a woman's hat, eyeglasses, toothbrush and powder, a miniature camera and film, a razor, a can opener, specimens of our money and so on.

In addition there are samples of the major metals and alloys; textiles, including wool, cotton, silk, linen, rayon, glass fabrics, rubber fabrics, asbestos cloth; materials such as Portland cement, asbestos, synthetic and natural rubber, synthetic plastics; also samples of coal (which may be rare in 5,000 years), seeds of staple food crops, and many other items.

Possibly the most important item packed in the Time Capsule is a carefully prepared microfilm "essay" on our times, taken from books, almanacs, pictures, catalogues, etc., and arranged in logical order to cover all the major activities of human life.

Multi-lingual texts, a dictionary and an idiomatic lexicon will enable future historians readily to translate the texts of the microfilm. All film in the capsule is acetate, specially prepared for permanence. The microfilm essay contains more than 23,000 ordinary book pages, reproducing more than 10,000,000 words, and many hundreds of pictures. A microscope is enclosed to enable "futurians" to read the text. Complete directions in text and picture are given for the construction of a larger reading machine and a motion picture projection machine. For use in this machine is a newsreel enclosed, especially prepared for the people of A.D. 6939, containing nearly a score of historic, typical, or significant scenes of our day with sound.

SCIENTIFIC LECTURES OF THE COLLEGE OF PHYSICIANS OF PHILADELPHIA

The program for 1940–1941 of evening scientific lectures of the College of Physicians of Philadelphia is as follows. In all cases the lectures will open at 8:30 P.M.

September 25. Nathan Lewis Hatfield Lecture XXIV, George W. Corner, director of the department of embryology, the Carnegie Institution, Baltimore. "The Physiological Basis of Corpus Luteum Therapy."

November 6. S. Weir Mitchell Oration VIII, John F. Fulton, Sterling professor of physiology, Yale University. "Neurology and War."

December 4. Thomas Dent Mütter Lecture LIII, Allen O. Whipple, professor of surgery, College of Physicians and Surgeons, Columbia University. "Recent Studies in the Circulation of the Portal Bed of the Spleen in Relation to Splenomegaly."

January 8. James M. Anders Lecture XVI, Thomas Francis, Jr., New York University. "The Problem of Epidemic Influenza."

February 5. Mary Scott Newbold Lecture XLVIII, Thomas T. Mackie, assistant clinical professor of medicine, College of Physicians and Surgeons, Columbia University; attending physician, the Roosevelt Hospital. "Studies in Ulcerative Colitis."

March 5. Alvarenga Prize Lecture, Ernest W. Goodpasture, professor of pathology, Vanderbilt University. "The Cell-Parasite Relationship in Bacterial and Virus Diseases."

April 2. Nathan Lewis Hatfield Lecture XXV, George L. Streeter, Carnegie Embryological Laboratory, the Johns Hopkins University, Baltimore. "New Data on Embryogenesis in Monkey and Man" (illustrated).

May 7. James M. Anders Lecture XVII, Henry F. Vaughan, commissioner of health, Detroit, Michigan. "The Way of Public Health."

LECTURES FOR THE GENERAL PUBLIC

November 15. Chevalier Jackson, honorary professor of broncho-esophagology, Temple University School of Medicine. "The Bronchoscope." (Lantern and motion picture demonstration of the instrument, its uses and what it has contributed to medical science and public welfare.)

January 24. Hubley R. Owen, director of public health, Philadelphia. "Activities of the Department of Public Health, with Plans for the Future."

April 18. Richard A. Kern, professor of clinical medicine, University of Pennsylvania Medical School. "Allergy and You."

THE AMERICAN ORNITHOLOGICAL UNION

The fifty-eighth annual meeting of the American Ornithological Union was held at the New England Museum of Natural History in Boston and at the Institute of Geographical Exploration at Harvard University from September 9 to 15 with a registered attendance of three hundred and ten. Thirty-nine scientific papers were read—many illustrated by color slides or films. The three days of program sessions included a like number of evening entertainments, open house at the New England Museum, the annual dinner and business meetings of various sections. On Friday ornithologists in attendance took a field trip to favorable localities along the coast north of Boston. On Saturday and Sunday many visitors traveled to Chatham and Cape Cod, with a beach wagon trip to Monomoy Point to observe pelagic birds.

Officers elected for the new year were: *President,* Dr. James P. Chapin, New York City; *Vice-presidents,* George Willett, Los Angeles, and Dr. J. L. Peters, Cambridge; *Secretary,* Dr. Lawrence E. Hicks, Columbus; *Treasurer,* Rudyerd Boulton, Chicago; *Council,* James Savage, Buffalo, Dr. Josselyn Van Tyne, Ann Arbor, and Dr. Ira N. Gabrielson, Washington, D. C.

The Brewster Medal was awarded to Dr. James L. Peters, of Cambridge, for his four volumes published to date on "The Birds of the World." Two fellows—Stanley G. Jewett, Portland, Ore., and Robert T. Moore, Pasadena, Calif., and one corresponding fellow, Dr. Oliveirio Pinto, of Brazil, were elected.

In addition to 228 new associate members, eight new members were named: Oliver L. Austin, Tuckahoe, N. Y.; Joseph J. Hickey, New York City; George H.

Lowry, Baton Rouge, La.; Eugene E. Murphey, Augusta, Ga.; John R. Pemberton, Altadena, Calif.; Arlie W. Schorger, Madison, Wis.; Milton B. Trautman, Put-in-Bay, Ohio, and Lawrence H. Walkinshaw, Battle Creek, Mich.

The meeting in 1941 will be held in Denver in September.

THE AMERICAN MATHEMATICAL SOCIETY

AT the joint meeting of the American Mathematical Society and the Mathematical Association of America held at Dartmouth College, Hanover, N. H., from September 9 to 12, the following resolutions were adopted, upon the recommendation of the War Preparedness Committee, Professor Marston Morse, of the Institute for Advanced Study, *chairman:*

1. That all competent students in the secondary schools take the maximum amount of mathematics available in their institutions. In the case of many schools additions to the present curriculum will be necessary in order to furnish an adequate background for the military needs of the country.
2. That the colleges and universities at once make such revisions of their undergraduate courses in mathematics and add such courses to the curriculum as are necessary to prepare students in the elements of mechanics, probability, surveying, navigation and other essentials of military science.
3. That the graduate schools extend their courses in applied mathematics, such as dynamics, hydrodynamics, elasticity, aeronautics, ballistics, statistics, etc., and that advanced students be urged to become highly qualified in one or more fields of applied mathematics.

This is a first step in the fulfillment by this committee of its dual mission of education and research.

Sub-committees were constituted with chairmen as follows:

Research—Professor Dunham Jackson, University of Minnesota.

Preparation for Research—Professor M. H. Stone, Harvard University.

Education for Service—Professor W. L. Hart, University of Minnesota.

To aid in research, chief consultants were named in the following fields:

Ballistics—Professor John von Neumann, Institute for Advanced Study.

Aeronautics—Professor Harry Bateman, the California Institute of Technology.

Mechanical and Electrical Aids to Computation—Professor Norbert Wiener, the Massachusetts Institute of Technology.

Industry—Dr. T. C. Fry, Bell Telephone Laboratories.

Cryptanalysis—Professor H. T. Engstrom, Yale University.

Probability and Statistics—Professor S. S. Wilks, Princeton University.

SCIENTIFIC NOTES AND NEWS

THE autumn meeting of the National Academy of Sciences will be held at the University of Pennsylvania on October 28, 29 and 30.

THE autumn general meeting of the American Philosophical Society will be held on November 22 and 23, beginning at 10 A.M., on Friday. On that day recipients of grants from the research funds will present reports of the progress or completion of their projects. On Friday evening there will be a public lecture followed by a reception.

DR. JOHN VAN NOSTRAND DORR, consulting metallurgist, president of the Dorr Company, Inc., New York City, has been awarded the Perkin Medal of the Society of Chemical Industry for 1941. Presentation of the medal will be made at a meeting to be held by the society on January 10 at the Chemists' Club, New York.

DR. JOHN R. MOHLER, chief of the Bureau of Animal Industry, U. S. Department of Agriculture, Washington, has been chosen Kober lecturer for 1941 under the rules governing an endowment fund established by the late Dr. George M. Kober. Dr. Mohler will deliver the lecture on March 28. He will speak on "Undulant Fever," under the auspices of Georgetown University.

CLOYD M. CHAPMAN was awarded honorary membership in the American Society for Testing Materials at its forty-third annual meeting "in recognition of his work in developing a system of medical x-ray photography, which makes it possible to examine a large number of individuals a day at a very moderate cost."

DR. GERALD WENDT, retiring director of Science and Education at the New York World's Fair, was the guest of honor at a party given at the Television Theater of the RCA Building at the fair on September 25, at 5 P.M. The event was arranged "in recognition of Dr. Wendt's services during his three-year connection with the fair and to present a preview of a collection of three-dimensional pictures recently taken by him of well-known scientific men at work on current research projects in their laboratories."

THE *Journal* of the American Medical Association reports that the Monroe County, Indiana, Medical Society recently held a dinner meeting in honor of

Dr. Burton D. Myers to mark his retirement as dean of the Indiana University School of Medicine at Bloomington. Dr. Myers had been dean of the school since 1927. He joined the faculty in 1903 as professor of anatomy, becoming assistant dean in 1920. He retired on July 1 having reached the retirement age of seventy years. At the dinner Dr. Myers was presented with life membership in the Monroe County Medical Society. The speakers included Dr. Karl R. Ruddell, Indianapolis, president of the State Medical Association; Dr. Herman B. Wells, president of Indiana University; Dr. William Lowe Bryan, president emeritus of Indiana University; Attorney George Henley, and Thomas A. Hendricks, executive secretary of the State Medical Association.

Dr. Thomas Byrd Magath, of the Mayo Clinic, Rochester, Minn., was elected vice-president of the Minnesota State Board of Health at a meeting held on August 29 in Minneapolis.

Dr. Wesley C. George, professor of histology and embryology at the School of Medicine of the University of North Carolina, has succeeded the late Dr. Charles S. Mangum as head of the department of anatomy.

Thomas B. Drew, supervisor in the engineering department of E. I. du Pont de Nemours and Company, Wilmington, Del., has been appointed associate professor of chemical engineering at Columbia University.

Dr. Cyrus C. MacDuffee, professor of mathematics at the University of Wisconsin, has been appointed professor at Hunter College, New York City. He will fill the vacancy left by the retirement of Dr. Lao Genevra Simons, chairman of the department.

At the Michigan College of Mining and Technology Dr. Henry L. Coles, head of the department of chemistry and metallurgy at the University of Alabama, will take the place of Dr. C. M. Carson, who retires as head of the department of chemistry and chemical engineering after serving for more than twenty-five years. Dr. Ralph E. Menzel, head of the department of chemistry of Phillips University, Enid, Okla., has been appointed an assistant professor.

Additions to the faculty of Cornell University, some of which have been already announced, are as follows: *Chemistry,* Professor Peter Debye, as chairman of the department; *Physics,* Bruno Rossi, associate professor; *Psychology,* Richard Parmenter, assistant professor; *Engineering,* Ebon H. Carruthers, assistant professor of metal processing; *Agriculture,* Karl C. Hamner, assistant professor of plant physiology, in charge of plant investigations in the U. S. Plant, Soil and Nutrition Laboratory at Cornell, Gordon H. Ellis, assistant professor of biochemistry and nutrition and biochemist in the Federal laboratory, Robert B. Musgrave, assistant professor of field crops and assistant agronomist, field station.

In addition to the appointment, recently announced in Science, of Dr. Otto Loewi, as research professor of pharmacology in the College of Medicine of New York University, Dr. Daniel Bartholomew Kirby, visiting surgeon in charge of ophthalmological service at Bellevue Hospital, has been appointed professor of ophthalmology.

Dr. Lewis C. Scheffey, clinical professor of gynecology at the Jefferson Medical College of Philadelphia, has been elected professor of gynecology to succeed Dr. Brooke M. Anspach, who retired rcently with the title professor emeritus. Dr. Anspach had held the chair of gynecology since 1921 and had been a member of the faculty since 1917.

Dr. Frederick R. Whittlesey, associate professor of medicine at the School of Medicine, at Morgantown, of the West Virginia University, has been appointed director of the dispensary and coordinator of clinics at the College of Medicine, at Omaha, of the University of Nebraska.

Dr. Philip L. Harris resigned from the faculty of the Medical College of South Carolina on September 1. He is now in charge of the Biological Laboratory of Distillation Products, Inc., Rochester, N. Y.

Charles R. McLendon, formerly city editor of the *New York Herald Tribune,* and also a member of staffs of *The Sun* and the *World-Telegram,* has been made editor of *Popular Science Monthly.*

Dr. Helen S. Mitchell, research professor of nutrition at the Massachusetts State College, has been requested to act as nutrition consultant with the Council for National Defense. She will work with Dr. Hazel Steibeling, senior food economist of the Bureau of Home Economics, Washington, in preparation for an educational program to contribute to the national health in time of emergency.

Several members of the staff of the Field Museum of Natural History are now engaged in national defense activities. Clifford C. Gregg, director of the museum, has been ordered into active service for a period of one year as a major of infantry in the United States Army. He has been assigned to staff duty at the headquarters of the Sixth Corps Area in Chicago. Museum men who have enlisted in the National Home Defense Guard of Illinois include Paul O. McGrew, paleontologist, and Bryan Patterson, assistant curator of paleontology.

Dr. Franklin S. Harris, president of Brigham Young University, has returned after a leave of absence of thirteen months during which he served as agricultural adviser to the Government of Iran. He helped to reorganize the Iranian Department of Agriculture. Part of his work was to establish a Bureau of Forestry. He also assisted in the solution of problems of irrigation, soils, transportation and colonization.

In the address as president of the American Chemical Society of Dr. S. C. Lind, printed in the last issue of Science, on page 230, column 1, third paragraph, the second line from the bottom, the number 450 should be 4,500.

The Clinical Congress of the American College of Surgeons will be held in Chicago from October 1 to 25.

Members of the Optical Society of America are invited to visit the following exhibits arranged by the industries of the city and the University of Rochester during the twenty-fifth annual meeting that will be held on October 3, 4 and 5. These include Eastman Kodak Company, Thursday, 2:00 P.M. A tour of the Kodak Research Laboratories including the Departments of Radiology, Sensitometry, Photometry, Microscopy, Photomicrography; Motion Picture Studio; Special instruments—Microdensitometer, Recording Spectrophotometer, Electron Microscope. The University of Rochester, Thursday, 9:30 P.M. Department of Physics—Cyclotron; Institute of Optics—Measurement of solar radiation, determination of ozone in the atmosphere. The Taylor Instrument Companies, Friday, 1:00 P.M. Luncheon followed by a trip through the plant. Inspection of manufacture of—Thermometers, Barometers, Compasses, Industrial Control Instruments. The Bausch and Lomb Optical Company, Friday afternoon. Plant visit and Instrument Display.

A large collection of birds from Indo-China has been sent to the Smithsonian Institution by Dr. Joseph F. Rock, American botanist and ethnologist. The collection includes three specimens of the giant ibis. Dr. Rock was able to obtain a fine collection of the larger birds of the area. These included marabou storks, herons and other water birds. Among the smaller specimens are representatives of several species unknown until they were found by a Swedish expedition in the same area within the past few years. The collection contained nearly eight hundred specimens.

At the beginning of the two hundred and fortieth year of the founding of Yale University, Silliman College, completing the group of ten undergraduate colleges, as originally planned, was opened on September 23. It is named for Benjamin Silliman, professor of chemistry and geology from 1802 to 1853. The building stands on the block bounded by College, Grove, Temple and Wall Streets. It includes the former Vanderbilt dormitories, given by the late Frederick W. Vanderbilt, of the Sheffield Scientific School class of 1876, and Byers Hall, given in memory of Alexander MacBurney Byers, of the Sheffield School, by members of his family. There are accommodations for 250 students, five resident fellows, rooms for visiting alumni, a dining hall, student common rooms and library. Professor Filmer S. C. Northrop, professor of philosophy and member of the Yale faculty for seventeen years, has been appointed master of Silliman College.

Cornell University has awarded forty-four John McMullen Regional Scholarships in Engineering to entering students from twenty-two states. The number is larger than usual this year because of a new ruling by the Board of Trustees giving the faculty committee authority to vary the stipends within limits in order to meet the specific needs of the applicants. The majority of the scholarships, however, carry $400 a year during the entire four- or five-year course in the College of Engineering. These scholarships are awarded annually to secondary school graduates in 15 districts covering the United States except the State of New York, where other scholarships are provided. They are financed from the proceeds of the fund established by the late John McMullen, of Norwalk, Conn., "for the purpose of creating and maintaining free scholarships for the education of young men as engineers." Industrial scholarships, undergraduate scholarships and graduate scholarships are also supported from this fund, which now amounts approximately to $2,000,000.

Nature states that the British home secretary recently announced in the House of Commons that he is willing to consider steps to enable alien men of science who are not released from internment to carry on their scientific activities or studies in internment.

DISCUSSION

RHESUS MONKEYS (MACACA MULATTA) FOR AMERICAN LABORATORIES

The Bureau of Biological Survey issued permits for the following numbers of Rhesus monkeys to be imported into the United States mainly for scientific laboratories: 1936: 12,992; 1937: 12,421, 1938: 15.851. Thus the actual average monthly importation from 1936 to 1938 inclusive was about 1,144, less mortality during shipment from India.

These figures show the magnitude and importance of the trade in Rhesus monkeys for the many kinds of medical and other scientific research. The data also show that previous estimates were exaggerated which gave the numbers of monkeys imported as being between 30,000 and 50,000 per annum.

Assuming that these primate specimens are essential to the work of American investigators, two important questions arise: 1. Will this drain on the Rhesus monkey population seriously limit or in fact deplete the supply in India? 2. Since various embargoes have been imposed during recent years, is there a possibility of serious limitation which would curtail important scientific research?

I tried to find the answers to these questions when I was in India and the Far East during July, August and September, 1938, collecting a breeding stock for the Santiago Primate Colony of the School of Tropical Medicine, Puerto Rico and Columbia University.

A clear and unequivocal answer was found to the first question: The center of the trapping operations is in the district around Lucknow where Rhesus monkeys are ubiquitous, are found by the hundreds of thousands and are even considered as pests. Throughout great sections of India where no trapping is being done at present, Rhesus monkeys are found in large numbers. The bonnet macaques in Southern India constitute a further possible supply. The Government of India has at times caught animals in the farming plain districts and shipped them by carloads to forest districts in order to protect the crops of fruits and grains. Since the monkeys are very numerous, since they are prolific breeders and since, in the main, only juvenile animals are trapped for export, there is no question of extinction from trapping or even of serious limitation of the supply.

The second question is problematic. Monkeys in India are considered to be quasi-sacred by Hindus and Buddhists. These peoples resent their capture and export under the prevailing deplorable conditions and they are told that the monkeys are used for the "rejuvenation of decadent Westerners." The Society for the Prevention of Cruelty to Animals, both in America and India strives to prohibit this primate traffic. These pressure groups succeeded in having the following resolution adopted by the Government of India in 1937:

> In exercise of the powers conferred by Section 19, the Sea Customs Act, 1878 (VIII of 1878), and in supersession of notificaion of the Government of India in Financial Department (Central Revenue) No. 23 Customs, dated the 3rd of April, 1937, the Central Government are pleased to prohibit the export of monkeys by sea or by land from British India during the period from 1st of April to 31st of August in each year.

Furthermore, the Coaching Tariff No. 11 of Indian railways prohibits the carrying of monkeys during the stated season. Exceptions are made for the School of Tropical Medicine, London.

The season of prohibition is delimited to April through August because of the high temperatures prevailing in India at that time in consequence of which many monkeys suffocate during rail shipment to coast ports. No consideration has been given to the fact that specimens shipped from India during the late fall and early winter months arrive about 40 days later in the often severe cold winter of Boston or New York, where most freighters from India first dock. Nor has consideration been given to the climatic zones of the Red Sea or the Cape of Good Hope through which shipments must pass.

Even during normal peace times, shipping problems are acute. Animals are packed in bamboo cages for rail shipment to Calcutta or Bombay. During these journeys a high percentage (estimated 10–20 per cent.) are either killed in fights, severely wounded or die from suffocation or the lack of water. Most animal depots in the seaports are filthy and monkeys are exposed to the disease-carrying humans usually found around these depots. The conditions under which animals make the 40-day journey to the United States are in most cases equally deplorable. Most ship operators do not like to carry this live freight and many have rules against its transport. At present shipping space is in great demand and invariably officers of ships must receive heavy gratuities to get them to tolerate the nuisance of shipments of monkeys. Since no ships have adequate accommodations for live primates, they fare poorly and from 6 to 40 per cent. die on shipboard. In addition, shipping charges are deliberately made high in order to discourage shipment of these primates.

All those interested in bettering these conditions; the scientists who use them, the Hindus and Buddhists, the Society for the Prevention of Cruelty to Animals and conservationists, should have a common interest in working out feasible plans for providing near optimum shipping conditions for these monkeys. A study of the problem indicates that proper approach to the Government of India, to the shipping officials and to dealers would greatly improve conditions affecting this necessary import of primates.

It should also be noted that a small percentage of the Rhesus monkeys necessary for American laboratories could be supplied by breeding colonies such as the Santiago Primate Colony in Puerto Rico. There is no reason why some specimens can not be bred near centers of adequate food supplies in southern and southwestern United States. The possibility of substituting New World platyrrhine types for the Rhesus should receive due consideration, also.

Study of the problem leads me to suggest the following:

1. The entire problem should be more carefully studied by a government agency or foundation before serious shortages occur.
2. A diplomatic approach should be made to the Government of India through the United States Consulate in Calcutta, requesting their cooperation.
3. Trappers and shippers in India as well as importers in the United States should be licensed and compelled to meet certain stated requirements.
4. All Rhesus specimens leaving India should be tested for tuberculosis and the positive reactors eliminated.
5. A study should be made of the need for these primates and this demand should be coordinated throughout the year with trapping operations in India.
6. Agreements should be made with shipping lines which will handle this traffic so that they will provide shipping facilities and adjust their charges accordingly.
7. Shipments of monkeys should be accompanied by trained caretakers.
8. Shipments should be timed and routed taking into consideration the weather conditions prevailing at various times of the year and the effect on Rhesus shipments. The Red Sea should be avoided at certain seasons (after the Mediterranean is again open) and during severe winter weather, shipments could be sent to the West Coast or to Southern ports, *e.g.*, New Orleans, instead of Boston and New York.
9. An adequate balanced ration and not solely unhulled rice should be required for animals during shipment.
10. Rhesus monkeys could be purchased directly from reliable agents in India at a considerable saving to scientific laboratories.
11. Breeding colonies for a limited number of disease-free, selected, dated and conditioned specimens should be established in the United States or nearby in the Western Hemisphere.
12. Consideration should be given to the possibility of using the New World platyrrhine monkeys in experiments where they can be substituted for the Rhesus monkeys.

Assuming that a supply of Rhesus monkeys or of other *Macaca* is essential for American laboratories, some of these recommended steps would seem highly desirable if not imperative.

C. R. CARPENTER

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MUSCA DOMESTICA AND HIPPELATES FLIES—VECTORS OF BOVINE MASTITIS

RECENT work at the Florida Agricultural Experiment Station on transmission of bovine mastitis shows that at least two species of insects, namely, the common housefly, ***Musca domestica,*** and frit flies or eye gnats, ***Hippelates*** spp. to be important vectors of the infection. Close observations made on diseased animals in affected herds showed that *M. domestica* were persistent in their feeding habits at the teat orifice of lactating cows in the milking line and of cows corralled near the barns. They fed on waste milk accidentally spilled on floors during milking operations. ***Hippelates*** were noted to hover around the natural body openings of calves, yearlings, pregnant heifers and lactating cows. *Hippelates* fed on lacrimal fluid, fatty body secretions, milk droplets accidentally spilled on the feet and on secretion at the tip of the teat of animals in herds where mastitis has prevailed. Structural characters, breeding habits and feeding activities of *M. domestica* and *Hippelates* flies aroused suspicion that these insects could serve as ideal vectors of mastitis.

Exposure tests were made to ascertain the possible relation these species might have to udder infection by their feeding habits at the teat orifice. The insects were taken from herds where mastitis has prevailed. In some instances alternate feedings on infected material and the teat orifice were made, while in other instances the teat orifice was exposed to insects taken directly from premises where mastitis prevailed. Mastitis developed in each of the experimental animals by the exposure technique employed. The type of udder infection, whether temporary or permanent, depended upon several factors. Active infections developed where the udder secretion was allowed to remain in the quarter as occurs naturally during the drying-off period prior to calving. Under natural conditions *M. domestica* and *Hippelates* fed simultaneously at the teat orifice of animals in corrals and many exposures were effected throughout the day during the insect season. While this work points out importance of insect transmission of bovine mastitis and opens up new fields of investigation it does not convey the idea that mastitis may not be transmitted by other means. Since *Hippelates* have previously been incriminated in the transmission of conjunctivitis and yaws (*framboesia tropica*) in humans it would not seem unreasonable to suspect these insects serve as vectors of other infections such as Brucellosis in cattle *via* the conjunctivae, mouth, teat orifice, vagina and skin. Buchli has shown these routes to be the portals of entry of ***Brucella abortus*** in cattle.

D. A. SANDERS

FLORIDA AGRICULTURAL EXPERIMENT STATION

EVIDENCES OF PLEISTOCENE CURRENTS IN PENINSULAR FLORIDA

THE Aero Service Corporation in Philadelphia have recently completed, on a scale of 1:40,000, an aerial survey of the southern third of the peninsula of Florida. The photographs had been assembled on a rough mosaic basis on great boards, and matched with a remarkable degree of accuracy. Southeast of Lake Okeechobee the small lagoons were arranged along lines of N 30 W. In the area west and northwest of Lake Okeechobee the lagoons and probably sand ridges were arranged along lines of N 45 W. Southwest and west of Miami the lines were arranged in broad sweeping curves convexed toward the east, approximating the curve of the Florida Keys.

The impression produced was very striking. The probable explanation is that this arrangement is due to currents, or currents and winds acting together during Pleistocene time, when all of this portion of Florida was covered by shallow sea.

ROY E. DICKERSON

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THE USE OF THE TERMS POLYGAMY, POLYGYNY AND POLYANDRY

THE term polygamy is frequently used as a synonym of polygyny in zoological writings. Polygamy, however, is an inclusive term, referring to the custom of having more than one mate, and includes both polygyny and polyandry. Since there is a definite meaning and a need for each of the three terms, it seems most desirable to stop the degradation of meaning and use the terms as defined in Webster's New International Dictionary, 1935:

Polygamy. The custom or practice of having a plurality of wives or husbands at the same time.

Polygyny. The mating of one male with several females, in certain animals, as fur seals.

Polyandry. The possession by a woman of more than one husband or mate at the same time.

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SCIENTIFIC BOOKS

STATISTICAL MECHANICS

The Principle of Statistical Mechanics. By RICHARD C. TOLMAN. Oxford University Press, 1939.

THIS new book of Tolman will be welcomed by every one interested in the fascinating field of statistical mechanics. Since an earlier book by Professor Tolman on the same subject, in the reviewer's opinion, remains one of the best introductory texts, one knew what to expect. The new book, however, far from being in any way a new edition of the older work, has a completely different character. Its purpose is to elucidate in detail the principles of the subject, especially in so far as they have been influenced by the development of the quantum mechanics. Except in the book of Von Neumann (which lies beyond the mathematical horizon of most physicists), this task had never been attempted. And this attempt alone makes it an important and useful book. In fact, it seems a pity that Tolman has not restricted himself to this sole task. In addition his book contains a straightforward text of the quantum mechanics (Chapter VII) and a discussion of the usual kind of applications (in Chapters X and XIV). These sections could have been omitted without loss to the main argument. They are quite satisfactory in themselves, but they are addressed, so to speak, to a different audience from that of the rest of the book.

The main part of the book may very well be compared with the famous article by P. and T. Ehrenfest in the "Enzyclopädie der Mathematischen Wissenschaften." There the principles of statistical mechanics were analyzed on the basis of the classical mechanics. Ehrenfest was able to show that many additional assumptions had to be made in order to explain the second law of thermodynamics. The clarity of his exposition has had a strong influence on the further development of the subject. And before going any further it may be said that Tolman's book reaches the same high standard of lucid and careful exposition. The two treatments of course exhibit several differences. The most important one is the difference in attitude with regard to the work of Gibbs. Ehrenfest has always held the opinion that Gibbs had only simplified and systematized the ideas of Boltzmann. Tolman, on the other hand, considers the Gibbsean concept of the canonical (and grand-canonical) ensemble as absolutely fundamental. He of course admits that for its justification one has to make certain assumptions, but he considers these as inherent to any kind of statistical approach. Furthermore, he tries to show that essentially the *same* assumption (the hypothesis of equal *a priori* probalities) has to be made in the classical as in the quantum statistics. The close analogies which exist between these two fields are very striking indeed. Tolman has emphasized these analogies by making the part of the book devoted to the classical statistics (Chapters III till VI) completely parallel to the part dealing with the quantum statistics (Chapters IX till XII). Even the wording is sometimes almost the same. Both parts culminate in the discussion of the H-theorem, which is thus given the central position it deserves.

All this surely is very illuminating. However, the reviewer must admit that the analysis of Tolman has not quite convinced him of the validity of the Gibbsean point of view, although as an old pupil of Ehrenfest, he may perhaps be prejudiced.

Since this is not the place for a detailed discussion, the reviewer will try to express in general terms his objections or perhaps better his feelings of discomfort. It is clear that the main difficulty lies in the explanation of the time-dependent processes in statistical physics. In fact, the fundamental problem is always to reconcile the reversible laws of mechancis with the apparent irreversibility of most of the phenomena which occur in nature. With regard to the theory of the properties of matter in equilibrium, there is in practice no difference of opinion. There are different ways of interpreting and justifying the canonical ensemble. But they all lead to the same general method for calculating the thermodynamic properties of a system, when the molecular constitution and the laws of interaction between the molecules are known. Of course this general method can not usually be carried out because of the great mathematical difficulties. And it is therefore perhaps not *quite* sure whether all the equilibrium properties can in principle be explained in this fashion. There is, for instance, the question of the existence of different phases of the same substance and the corresponding problem of the phase transitions, like condensation and melting. There are only the beginnings of an understanding of the liquid state. And so one can go on; the strict theory of all these matters, starting from first principles, is still lacking, although several interesting attempts have been made. Tolman does not consider these questions. Their critical discussion would doubtless have increased the book beyond all measure. They should have perhaps been mentioned at least, because they are (or better should be) essential applications of the general methods, describing the properties of systems in the equilibrium state.

However, as said before, the main difficulties lie in the explanation of the phenomena in systems *not* in the equilibrium state. And the first problem is to show that the equilibrium state, as described by the canonical ensemble, is always reached in time. This is what the x-theorem tries to do, and it is here that the differences of opinion occur. One has to distinguish between the original H-theorem of Boltzmann, which only holds for ideal gases, and the generalized H-theorem of Gibbs, which deals with the ensemble for an arbitrary system. The proofs for these two theorems have quite a different character. For gases one can actually write down an expression for the rate of change of the function H, so that one not only shows that the equilibrium state is always reached in time, but one has also an idea how long it will take. One can estimate the relaxation time. In the background, so to speak, there is also the exact theory of the transport phenomena (heat conduction, diffusion, etc.), which gives a satisfactory explanation of at least some of the non-equilibrium phenomena in gases. The situation is quite different for other systems, as in the cases of liquids and solids. Even if one is convinced by Gibbs's proof that the equilibrium state is always reached in time—and the analysis of Tolman has made the proof really quite convincing—still one has no way of estimating the relaxation time. As a result, there does not exist a strict theory, say, for the viscosity of a liquid, and in the reviewer's opinion this is *not* only due to mathematical difficulties, but it is even not clear how to formulate the problem mathematically, supposing always that the molecular constitution of the liquid and the interaction laws between the molecules are known.

This is really the main reason why the reviewer feels dissatisfied with the treatment of Gibbs and Tolman. Ehrenfest used to say that the book of Gibbs was too "smooth"; that it gave too much the impression that all problems in statistical physics were in principle solved when one could believe the classical mechanics. And the same kind of impression may be gotten from Tolman's book. This, of course, does not detract from its value. But it is the reason why the reviewer has tried to emphasize the questions which still remain open. Statistical physics has been rather neglected by the theoretical physicists, and only the simple problems have really been solved.

GEORGE E. UHLENBECK

UNIVERSITY OF MICHIGAN

SPECIAL ARTICLES

THE AUTONOMIC BASIS OF EMOTION[1]

CANNON[2] has stressed the significance of the sympathetico-adrenal discharge in emotion in a number of important papers. He attributes less significance to discharges via the parasympathetic system, although he admits that under conditions of great fear signs of parasympathetic discharge may be present together with the well-known sympathetico-adrenal syndrome. This latter phenomenon he explains by a lack of "orderliness of central arrangement" so that the "opposed innervations no longer discharge reciprocally but simultaneously and then the stronger member of the pair prevails." Several authors (Kling,[3] Bekhterev,[4] Bergmann[5] and others) have shown that, at least in the human, vagal discharges frequently accompany emotional processes.

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[1] Aided by a grant from the John and Mary R. Markle Foundation.

[2] W. B. Cannon, "Bodily Changes in Pain, Hunger, Fear and Rage," New York, 1929; and "The Wisdom of the Body," New York, 1939.

[3] C. Kling, *Psychological Review*, 40: 368, 1933.

[4] V. M. Bekhterev, "Feelings and Emotions." Edited by M. L. Reymert, Clark University Press 1928, p. 270.

[5] G. Von Bergmann, Funktionelle Pathologie, Berlin, 1936.

It was shown recently by ourselves[6] that the inhalation of low oxygen as well as the administraiton of metrazol produces in rats definite signs of a simultaneous vago-insulin and sympathetico-adrenal discharge. The predominance of the sympathetico-adrenal system explains the fact that in normal animals anoxia and metrazol cause a rise in the blood sugar. After elimination of the sympathetico-adrenal system these factors lead to a characteristic hypoglycemia. If, however, the vagi are cut below the diaphragm this hypoglycemic effect is absent. These experiments make it probable that conditions such as sham rage and rage which in the normal cat lead to marked discharges over the sympathetico-adrenal system may in animals in which the effects on this system have been eliminated reveal discharges over the vagus, leading to an increased secretion of insulin. Such experiments seem to be of great interest not only for the theory of emotion but also as a contribution to the still disputed problem in how far the vagus contributes to insulin secretion under physiological conditions.

In the first group of experiments the well-known syndrome of sham rage was produced by stimulating the left mamillary body of the hypothalamus in lightly narcotized cats by means of faradic currents. The Horsley-Clarke sterotaxic instrument was used in these experiments. Such a stimulation leads regularly to an increase in blood sugar due to sympathetico-adrenal discharge (Karplus and Kreidl,[7] Ranson[8] and collaborators). If the adrenals are eliminated and the liver is denervated, such stimulation, although still accompanied by the marked sympathetic signs of sham rage, is accompanied by a reversible fall in blood sugar. If, however, the experiment is repeated in such animals after the vagi had been cut the result of stimulation is now a slight rise in blood sugar which is much weaker than that observed in animals with the sympathetico-adrenal system intact. It seems highly probable that this latter rise is due to a secretion of sympathin (*cf.* Partington[9]). The fall in blood sugar observed in the first part of the experiment must be attributed to an increased secretion of insulin mediated by the vagi.

These experiments are confirmed in a second group of experiments in which the spinal cord was sectioned below the sixth cervical segment, and hypothalamic stimulation was carried out eighteen hours later. Here again it was found that sham rage produced hypoglycemia when the vagi were intact, but a slight delayed rise in blood sugar occurred on hypothalamic stimulation after vagotomy.

Another group of experiments was conducted on cats in which again the spinal cord was sectioned at the sixth cervical segment in order to eliminate the effect of central sympathetic discharges on the sympathetico-adrenal system. When such cats were confronted with a barking dog, whereby a typical rage reaction was elicited, the blood sugar fell in spite of marked signs of rage such as pupillary dilatation, increased respiration, unsheathing of the claws, etc. If, however, the experiment was repeated after the vagi had been cut below the diaphragm the result of the rage reaction was now a slight increase in blood sugar. Whether this increase is due to sympathin or to some stimulation of the hypophysis remains to be investigated. The experiments have clearly proven that the natural emotional process of rage as well as sham rage induced by hypothalamic stimulation lead to a simultaneous discharge over the vago-insulin and sympathetico-adrenal system.[10] It is obvious that it will be very important to study the evidence of such vago-insulin action under conditions of emotional disturbances.

SUMMARY

(1) It is shown that hypothalamic stimulation in cats, with faradic currents eliciting the syndrome of sham rage, produces after the elimination of the sympathetico-adrenal system a hypoglycemia when the vagi are intact. After bilateral vagotomy the stimulation results in a slight and delayed rise in blood sugar.

(2) If in cats in which, due to a sectioning of the spinal cord at the sixth cervical segment, the effect of central discharges on the sympathetico-adrenal system is eliminated, a rage response is elicited by a barking dog it produces a fall in blood sugar. The sectioning of the vagi below the diaphragm abolishes this reaction.

From these experiments it is concluded that the normal emotional process as well as the sham rage reaction is characterized by a simultaneous discharge over the vago-insulin and sympathetico-adrenal system. The latter predominates in the normal animal and masks the effects on the former.

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[6] E. Gellhorn, paper read at Cincinnati meeting of the American Psychiatric Association, May, 1940.

[7] J. P. Karplus and A. Kreidl, *Arch. ges. Physiol.*, 135: 401, 1910.

[8] S. W. Ranson and H. W. Magoun, *Ergebn. Physiol.*, 41: 56, 1939.

[9] P. P. Partington, *Amer. Jour. Physiol.*, 117: 55, 1936.

[10] It is interesting to note that Harris and Ingle (*Am. Jour. Physiol.*, 120: 420, 1937) observed in adrenalectomized rats a fall in blood sugar under conditions of fright which evoked a hyperglycemic effect in the control animals. These authors failed, however, to see the significance of their findings and the role of the vagus in insulin secretion. They attribute their results to an artefact.

A PRELIMINARY NOTE ON THE EXTRACTION OF A CARCINOGENIC FACTOR FROM PRIMARY HUMAN MAMMARY CANCER[1]

THE following are the preliminary results of an experiment in which extracts of two human mammary cancers produced tumors at the site of injection in experimental animals.

In reviewing the extensive work that has been done on the hydrocarbon carcinogenic agents, their chemical and physical properties and relation to the normal sterols of the animal body, the common property of the fat solubility seems to stand out as a characteristic that might also be common to a hypothetical human carcinogenic factor. If such a factor exists, it would likely be extractable by fat solvents, and the site of an early primary growth would serve as an indicator of the region of greatest concentration locally. Since the solubility of the factor was unpredictable, and it seemed likely that it would be present in minute quantity, the use of several solvents would increase the chance of complete extraction.

With the above assumptions in mind the following experiment was performed. On August 23, 1939, a small, 2 cm × 2.5 cm, scirrhous type carcinoma with axillary node involvement was removed by right radical mastectomy. After small blocks of tissue had been excised for fixation and microscopical examination, the primary nodule with its immediately surrounding fatty tissue was dissected free of the remainder, ground to a hash, covered with cold acetone and stored in a refrigerator. Acetone was used to serve both as a solvent and as a dehydrating agent to prepare the tissue for later ether extractions. The material was then placed in a Soxhlet extractor and extracted exhaustively at the lowest possible temperature with the following solvents in this order: 1. acetone, 2. ethyl ether, 3. petroleum ether (B.p. 35–60° C.), 4. absolute ethyl alcohol. In an attempt to minimize chemical change, this order was maintained to remove as much fat soluble matter as possible before the higher temperature of the alcohol extraction. Separate portions of the hash were then each extracted with each solvent for at least 24 hours. The solvents were then removed by distillation at reduced pressure. The fractions were then combined for injection into experimental animals, advantage having been taken of the neutral fat as a solvent. This extract was designated H.M.Ca. Extract No. 1.

On October 10, 1939, a second human scirrhous carcinoma was obtained following a left radical mastectomy. The primary nodule measured 4.5 cm × 4.5 cm × 1.5 cm and metastatic cancer involved the axillary nodes. This tumor was extracted by an identical procedure and the final extract was designated H.M.Ca. Extract No. 2.

The experimental animals used were virgin female mice one month old of Little's C57 black low tumor strain. The strain has been maintained pure by brother-sister mating only and no spontaneous tumors have occurred in 200 control animals.

On September 12, 1939, 0.2 cc of H.M.Ca. Extract No. 1 was injected subcutaneously into the region of the left hind-most breast of 4 virgin females. Subsequent injections of 0.2 cc, alternating left and right hind-most breast regions, were given on October 11, 1939, November 21, 1939 and December 4, 1939. To avoid any continuous effect of whatever estrogenic substance the extract might contain, no further injections were given. These animals were each allowed a single pregnancy during the injection period. No animal was injected during lactation.

H.M.Ca. Extract No. 2 was first injected into the region of the left hind-most breast of 5 virgin females on November 17, 1939. One subsequent injection was given in the region of the opposite breast on December 3, 1939. All of these animals were kept virgin throughout the experiment.

The first tumor appeared on June 20, 1940, 282 days after the first injection of H.M.Ca. Extract No. 1. A hard subcutaneous nodule 0.5 cm in diameter was found at the very site of the first injection. This mass grew rapidly and on July 1, 1940, had reached 2 cm × 2.5 cm in size. The animal was sacrificed and a portion of the tumor was transplanted into 4 mice of the same strain. After microscopical preparation of the remainder, the tumor was found to be a rapidly growing spindle cell sarcoma. No gross metastases were found, but microscopically the mass extensively invaded the abdominal wall. The transplants grew rapidly in all of the animals and resulted in a 2 cm ulcerating mass by the twentieth day. Three of the animals died from the effects of the transplant between the twentieth and twenty-sixth day. On the twenty-sixth day the fourth animal, obviously dying, was sacrificed and the tumor was retransplanted. In each case an equally large internal mass was found in the abdominal cavity where the subcutaneous transplant had invaded the abdominal wall. No gross metastases were found in other regions of the body.

On July 3, 1940, 229 days following the first injection of H.M.Ca. Extract No. 2, a tumor appeared in this series of animals. This tumor also appeared at the very site of the first injection. It was allowed to grow until July 22, 1940, when it had reached 1.5 cm in size. A portion of this was transplanted into 4 animals and grew rapidly. Microscopical examination again revealed a spindle cell sarcoma. The mass had invaded the muscle to which it was adherent, but no gross metastases were found.

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[1] From the Laboratory for Surgical Research, Stanford University Medical School.

To date, no other tumors have appeared in either series of animals.

Apparently, for the first time, a factor has been extracted from primary human cancer which is capable of producing tumors in an experimental animal. Further trials of the above experiment are now under way, in addition to the obvious control experiments that will be necessary to establish this finding. Also, an attempt is being made to isolate the active factor from the pooled extracts of several human cancers. These results will be reported when they are completed.

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INSECT LIFE WITHOUT VITAMIN A

IN a series of earlier studies[1] it was found that *Blattela germanica* L., the ordinary cockroach, could grow to maturity upon a synthetic diet of purified casein, starch, salt mixture and yeast or yeast extract. Since this diet was very low in vitamin A, this species must either have synthesized this factor or have had no need for it. Inasmuch as vitamin A seems essential for all the higher vertebrates that have been studied, it is interesting that it may play no part in the life of one or possibly many species of insects.

A new series of experiments was devised to check the earlier results showing no dietary need for this vitamin. The work was then extended still further to determine whether or not the cockroach could synthesize this factor within its body when fed diets devoid of vitamin A or its precursor carotene. The stock diet that has been in use for many years by us for producing cockroaches is a mixture of equal parts of whole wheat flour and dried skimmed milk. This diet was exposed to hot air for six hours at 115° C. to destroy any carotene. The young cockroaches, started two days after emerging, grew better upon this heat-treated diet than upon the original. The purified diet deficient in vitamin A and used in the usual assay procedure for vitamin A was then tested as a stock diet. All these studies indicated that the cockroach could thrive upon diets that are so deficient in vitamin A that they will not support the growth of rats.

The next step to determine if this insect could carry on its body functions without vitamin A consisted in producing large numbers of the insects upon an A-free diet, extracting the fat from these insects and testing this fat for this vitamin.

By the use of large cages 2.5 kilograms of live cockroaches were produced in the course of ten months. These were reared upon the vitamin A-free diet used in the U. S. P. method for the vitamin assay with rats. From these insects were extracted very carefully in the cold 150 grams of oil. This oil was tested colorimetrically for vitamin A but gave only a negative test. It was then fed to rats in accordance with the usual procedure for the assay of vitamin A. Levels of 0.1 and 0.01 grams were fed daily in this assay. Neither level gave any indication of containing vitamin A. In the same assay the reference cod liver oil gave the usual response in growth and prevention of eye symptoms.

From these results it is evident that the cockroach needs no vitamin A in its diet and that its body can function normally throughout its life cycle without this vitamin. Therefore vitamin A is not of universal importance in the life of animals.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A DIFFERENTIAL METAL BELLOWS MANOMETER FOR THE MEASUREMENT OF BLOOD FLOW

THE differential rubber membrane manometer described in an earlier report for the measurement of blood flow by differential manometry[1] has been replaced by a pair of metal bellows manometers, arranged to record mechanically the difference in their pressure readings. The calibration of the manometer couple in this arrangement has remained constant over a period of eight months in almost daily use.

The bellows is a deeply corrugated thin-walled cylinder, which elongates under application of internal pressure.[2] The most flexible small bellows obtainable has an outside diameter of 25 mm and a length of 30 mm. Without load, it responds to internal pressure with elongation at the rate of approximately 0.04 mm for 1 mm Hg in roughly linear fashion up to at least 200 mm Hg. To adapt the bellows for differential manometry, a pair of them was mounted on suitable bases (Fig. 1, *a*) and clamped in position with their movable faces apposed so that each bellows exerted its full thrust against the other. Magnified mechanical recording of the movement at the apposed faces was accomplished by inserting between the faces a short sleeve (Fig. 1, *b*) bearing a rod onto which the short arm of a recording lever was slotted (Fig. 1, *c*). The sleeve was cut out as shown in the sketch, and fastened to the free face of each bellows with a small amount of solder. Maximum range is secured for the couple by mounting the bellows under minimum compression. The fulcrum which carries the recording lever is adjustable on the short rod *d*. The recording lever and its axle are shown only in the lateral view in Fig. 1.

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[2] Finney-Howell fellow in cancer research.

[1] C. M. McCay, *Physiol. Zool.*, 11, 89, 1938.

[1] Hampden Lawson and J. P. Holt, *Jour. Lab. and Clin. Med.*, 24: 639, 1939.

[2] The courtesy of the Fulton Sylphon Company, Knoxville, Tenn., who supplied the bellows from special stock, is gratefully acknowledged.

When coupled in this fashion, the elongation of each bellows for a given rise in pressure is reduced by one half, pressure in the other member of the pair remaining constant. Thus, with the diameter and flexibility given above the volume change for a pressure rise of 100 mm Hg is approximately 0.87 cc. Under most conditions the time required for the displacement of this volume of fluid does not constitute a serious error. Unless pressures high enough to produce lateral deformation are employed, the behavior of the firmly joined apposed faces resembles that of a single elastic membrane, in response to pressure differences in the two members of the couple. Equal pressure increases in either member, pressure in the other remaining constant, will produce equal and opposite movements of the writing point from the zero line, regardless of differences in the separate flexibility of the two bellows. Furthermore, since fluid displacement for a given pressure change is equal in the two members, resistance to flow anywhere in the system has the same effect as resistance anywhere else.

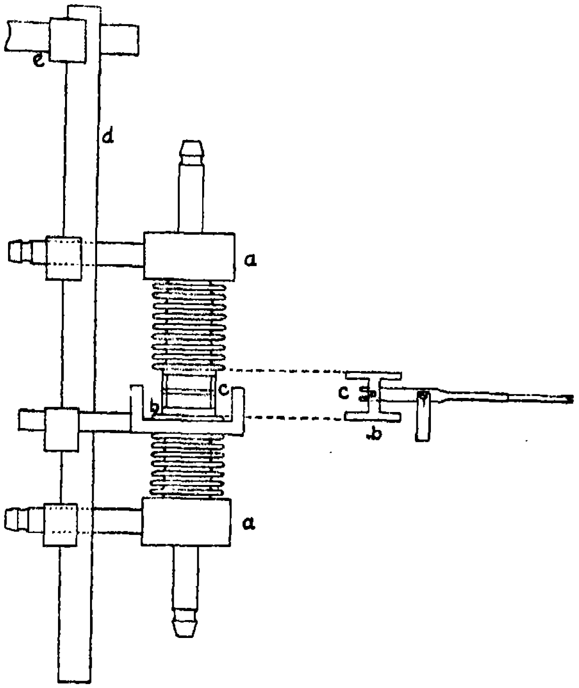

FIG. 1

The use of this type of manometer as a flow-meter for arterial blood flow was described in the earlier report. Water is used for filling the bellows and tubing, rather than citrate solution, as the latter corrodes the metal bellows. After cannulation and filling of the apparatus is complete, 5 per cent. chlorazol fast pink solution is injected into the cannulae and adjacent tubing as an anticoagulant. In filling the lower bellows, air is evacuated by rotating the couple on the rod *d* in the clamp *e* until the lower bellows is uppermost.

With arterial pressure acting on both bellows, there is usually a fairly wide swing of the writing point with each pulse wave, due to delayed arrival of the wave at the lower cannula. Up to a frequency of about 40 per min. in hydrostatic systems, equal but asynchronous pulsating pressures in the two bellows produce equal oscillations of the writing point about the true mean. With higher frequencies, such as occur in the arteries, there may be an error as great as 2 mm Hg in reading the true mean.

When the constricting clamp is placed on the artery between the two cannulae to permit the use of the apparatus as a flow-meter, the pulse wave as well as mean pressure in the lower bellows is reduced, and the now weakly opposed waves in the upper bellows produce large oscillations of the pointer. The legibility of the record may be improved by damping these with a screw clamp applied to the tubing leading to the upper bellows. The reading of the mean pressure difference is not affected by such damping.

The force acting at the apposed faces is approximately 5.85 gm for a pressure difference of 1 mm Hg. This permits the use of magnifying recording levers, giving 50–100 times magnification on the record. With a light lever giving a magnification of approximately 100 times, the apparatus in use has a period of 0.3 sec. Since this is of the same order as the natural period of most mercury manometers, the apparatus can indicate flow changes with such cyclic circulatory phenomena as can be recorded with a mercury manometer. The accuracy with which it records these is about the same as the accuracy of the usual laboratory mercury manometer in indicating pressure changes.

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PSYCHOLOGICAL APPROACHES TO THE BIOGRAPHY OF GENIUS[1]

By Professor **LEWIS M. TERMAN**
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PROBABLY few words have acquired a greater variety of connotations than *genius*. On this occasion I shall disregard the numerous meanings attached to the word in the first two thousand years of its history and call attention only to common usages in modern English.

In a popular sense genius is often used to designate some kind of mystical gift that can not be explained by the ordinary laws of human nature. The scientist, of course, rejects this usage. Havelock Ellis and others have used the term as practically synonymous with eminence. Galton, while employing the criterion of eminence, follows Samuel Johnson in defining a genius as one who is endowed with superior intellectual ability. This definition is essentially identical with that given in Warren's "Dictionary of Psychological Terms," 1934, and is the one I prefer.

The *sine qua non* of genius is the ability to acquire and to manipulate concepts, the shorthand symbols without which abstract thinking can not proceed. However, there are many levels of aptitude for concept mastery and the question arises where genius may be said to begin. We have at one extreme Dr. Fields' laboratory rats which required thousands of trials and a good part of their lives to learn to respond to triangularity in visual stimuli; that is, to acquire one crude concept. At the other extreme are the Newtons and the Aristotles. The intermediate levels range upward through infra-human intelligence, average human intelligence and the superior grades that permit higher and higher levels of abstraction. Any line that may be drawn to demarcate genius is purely arbitrary. Whether one restricts the term to the ablest in many millions, in a few thousand or in a few hundred, does not matter provided the facts are stated.

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[1] Presidential address before the Pacific Division of the American Association for the Advancement of Science, Seattle, June 18, 1940.

Another problem is that of identifying the individuals who qualify at a particular level of genius chosen for investigation. I have referred to the criterion of eminence. Unfortunately, eminence as measured by popular acclaim or even by space in biographical dictionaries is influenced by other circumstances than intellectual achievement. The population it affords is the result of innumerable selective factors which vary from age to age and from culture to culture. The genius who survives as such has successfully run the gantlet of premature death, the inanities of formal education, the social and ethical pressures of his immediate environment and the more general cultural influences that have given direction and content to the civilization in which he was born. To study only the biographies of historic characters gives us a one-sided picture in that it tells us nothing about the potential geniuses who failed to achieve greatly. To complete the picture it is necessary not only to investigate the life histories of eminent persons but also to inaugurate researches that will proceed in the opposite direction. That is, we should identify early in life those individuals who are intellectually gifted, secure quantitative measures of their mental and physical traits, then follow their careers through life.

For twenty years parallel studies in these two directions have been in progress at Stanford University. On the one hand, the mental development of 300 eminent individuals has been traced backward to childhood; on the other hand, the development of more than thirteen hundred intellectually superior subjects has been followed in the forward direction from childhood to early maturity. It is possible to give you this evening only a few highlights from these two lines of investigation.

I

I shall first review some of the more recent approaches to the biographical study of eminent persons. As you well know, the highly original publications of Francis Galton between 1869 ("Hereditary Genius") and 1889 ("Natural Inheritance") stimulated many interesting investigations of the origin and qualities of great men. Unfortunately, the methodology of these studies soon became stereotyped along statistical lines, with failure to take advantage of progress in individual psychology. It has long seemed to me that the writing of a biography is as much a psychological as a historical undertaking and that biographers fail as often from lack of psychological insight as from any other cause. Not infrequently an otherwise competent biographer overlooks crucial facts in his subject's mental life or else interprets them in ways that are psychologically unsound. It was a striking example of such erroneous interpretation that led me to apply to the Commonwealth Fund for a grant to finance a research on the early mental development of historical geniuses. At that time my study of California gifted children was under way and the possibility of cross illumination from the two lines of approach seemed promising.

The erroneous interpretation referred to was found in Karl Pearson's "Life, Letters and Labors of Galton." In a discussion of Galton's intellectual precocity Pearson had presented an extraordinary array of documentary evidence regarding his subject's early accomplishments. Francis learned to read at the age of two and a half years and wrote a letter before he was four that has been preserved. By the age of five he could read "most any English book" and some French, could cast up any sum in addition, had mastered all the multiplication table except the 9's and 11's, knew the table of English money and could tell time by the clock. Now it happens that all of these and several other dated performances of Galton have been standardized by psychologists on unselected children of different ages, and that the mental age necessary for each performance is known. By the use of such norms it is possible in the case of Galton to estimate with considerable assurance the lowest IQ that would account for the facts. This was unquestionably in the neighborhood of 200, a figure not equalled by more than one child in 50,000 of the generality.[2] Yet Pearson was so unaware of the significance of the performances he had described as to assert: "I do not think we can say more than that Francis Galton was a normal child with rather more than average ability."

The research for which funds had been provided was carried out by Catharine Cox and two assistants. The first task was to select a group of eminent subjects in such a way as to avoid the bias that is sure to enter when selection is subjective and haphazard. Cox began with Cattell's list of the 1000 most eminent individuals of history as determined by the space devoted to them in biographical dictionaries. Taking the 500 most eminent of Cattell's list, she eliminated from this group those born before 1450, those who belonged to the hereditary aristocracy or nobility, and a few others, arbitrarily, whose eminence had little or no basis in intellectual achievement. This left her with 300 subjects.

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[2] Lewis M. Terman, *Am. Jour. Psychol.*, 209–215, 1917.

Cox and her assistants combed the biographies of these subjects for data on early mental development as indicated by interests, education, school standing and school progress, friends and associates, reading, production and achievement. Special attention was given to evidence from documentary sources. The material thus assembled ran to 6,000 typed pages. The evidence for each subject was then examined independently by three psychologists who were intimately acquainted with age norms of mental performance. Their task involved two things: (1) estimation of the minimum IQ that would account for a subject's childhood performances, and (2) a rating of the reliability of the evidence on which the IQ estimate was based. The averages of the three estimates for all individual subjects were the primary data for this part of the study.

It must be emphasized that the IQ as reckoned is an estimate of the lowest IQ that could reasonably account for the recorded facts; the actual childhood IQ's of historical geniuses are of course indeterminate.

For the entire group the estimated minimum IQ's ranged from 100 to 200, with an average of 155. The average is more than three standard deviations above the mean of the generality. Low estimates in the range of 100 to 120 IQ occurred only when there was little biographical information about the early years. The mean was highest for philosophers (170), and next highest for poets, novelists, dramatists and revolutionary statesmen (160). The lowest was for soldiers (125), the next lowest for artists (140) and musicians (145). The mean for scientists (155) was identical with the mean for the total group.

It will be understood, I trust, that IQ estimates of this kind are not to be taken too literally. For a majority of the subjects the information on which the estimates were based was far short of what could be desired. However, despite all inadequacies of the data I believe that the author's main conclusion is warranted: namely, that the genius who achieves highest eminence is one whom intelligence tests would have identified as gifted in childhood. The author warns us that the converse of this does not follow; we may not conclude that every child who tests high will become eminent. Her data suggest that those who do achieve greatly are characterized not only by superior intellectual ability but also "by persistence of motive and effort, confidence in their abilities and great strength or force of character."

That personality traits are influential in determining both the level and the direction of achievement can not be doubted. We shall see later that this is certainly true of the gifted children I have studied. However, one must also take account of the part played by chance. For a given type of achievement to be possible one must be born not too far from a given time and place. It is an interesting game to try to imagine how differently any list of eminent persons might read if every one now in it had lived a generation or two earlier or later. The soldiers would nearly all bear strange names, perhaps a majority of the statesmen, especially revolutionary statesmen, and doubtless many of the writers and scientists.

Apart from time and place of birth, there are other chance factors in vast number that are capable of shaping the life of a gifted youth. Newton at 15 had left school and was tending his mother's farm; but for the timely visit of an uncle who had attended Cambridge it is unlikely that he would ever have received the education that made possible his great discoveries. Victor Cousin was bred in the gutter and was illiterate at the age of ten when he happened to befriend a bully's victim in a street fight, with the result that the latter's mother sought him out and gave him an education. Faraday left school at 13 and at 14 was apprenticed to a bookbinder. It was the reading of an article on electricity in an encyclopedia given him to bind that first stimulated his interest in science. Even this would probably have got him nowhere had not Humphrey Davy been near to lend a helping hand.

In a study like that of Cox, special interest attaches to certain eminent persons who have been cited as examples of childhood backwardness. In every one of these cases the facts clearly contradict the legend. Goldsmith was characterized by Samuel Johnson as "a plant that flowered late," and a childhood teacher said of him in her old age, "never was so dull a boy." Actually Goldsmith was writing clever verse at the age of 7 years and at 8 was reading Ovid and Horace. His IQ was probably 140 or higher. Sir Walter Scott is said to have been a dunce when he attended the Musselburgh school. The facts are that he never attended this school, that when only 7 years old he read widely in poetry and in his prose at this age used correctly such words as "melancholy" and "exotic," that by age 10 he had collected a small library of ballads and that at 13 he lay awake nights reading Shakespeare when he was supposed to be asleep. His IQ was at least 150.

Other alleged dullards represent a type often encountered in the old-fashioned Latin school, *i.e.*, the youth who hated Latin and Greek but had a natural talent for science. Liebig, the founder of physiological chemistry, was the despair of his language teachers. At 15 he left school and was apprenticed to an apothecary because he wanted to be a chemist. At 17 he managed to enter a university and at 20 was awarded the Ph.D. degree. John Hunter, British surgeon and anatomist, left Latin school at 13 and spent four apparently idle years roaming the woods and fields, "watching the ants, the bees, the birds, the tadpoles, and caddis-worms, pestering people with questions about which nobody knew or cared anything." Alexander von Humboldt and his brother Wilhelm, two years older, were privately tutored along the usual classical lines. Wilhelm liked languages and was early recognized as gifted; Alexander, caring only for nature, was considered mentally slow. Both became eminent, but Alexander outstripped his brother.

In the cases just cited one notes a tendency for the direction of later achievement to be foreshadowed by the interests and preoccupations of childhood. I have tried to determine how frequently this was true of the 100 subjects in Cox's group whose childhood is best documented. Very marked foreshadowing was noted in the case of more than half of the group, none at all in less than a fourth. Macaulay, for example, began his career as historian at the age of 6 with what he called a "Compendium of Universal History," filling a quire of paper before he lost interest in the project. Goethe's literary juvenilia are perhaps the most remarkable that have ever been preserved. Ben Franklin before the age of 17 had displayed nearly all the traits that characterized him in middle life; manual skill, scientific curiosity, religious heterodoxy, wit and buffoonery, political and business shrewdness and ability to write. At the age of 70, when on a diplomatic mission in England, he dug up an article which he had written in his teens, published it practically without change, and created a political sensation. At 11 Pascal wrote a paper on sound and was so interested in mathematics that his father thought best to deprive him of books on this subject until he had first mastered Latin and Greek. Pascal secretly proceeded to construct a geometry of his own and covered the ground as far as the 32nd proposition of Euclid. At 14 Leibnitz was writing on logic and philosophy and composing what he called "An Alphabet of Human Thought." He relates that at this age he took a walk one afternoon to consider whether he should hold the doctrine of substantial forms.

In working with data of this kind the investigator must of course be wary, for even under the pen of a conscientious biographer the childhood period is likely to be colored by the halo of adult achievement. The evidence, however, is indisputable in the case of nearly all the musicians, and hardly less convincing in the case of mathematicians and artists. There are few great poets who did not show unusual poetic talent before the age of 15.

We can go further and say that the literary style of a poet's juvenilia usually resembles that of his mature productions. Let me illustrate by a single example. I shall read to you a few lines from two poems, both of romantic content and both written at the age of 14. I am sure you will have no difficulty in guessing which was written by Alfred Tennyson and which by Samuel Johnson.

THE BRIDAL

The lamps were bright and gay
On the merry bridal-day,
When the merry bridegroom
'Bore the bride away!
And the chapel's vaulted gloom
Was misted with perfume.
"Now, tell me, mother, pray
Why the bride is white as clay,
Although the merry bridegroom
Bears the bride away."

TO A YOUNG LADY ON HER BIRTHDAY

This tributary verse receive, my fair,
Warm with an ardent lover's fondest prayer.
May this returning day forever find
Thy form more lovely, more adorn'd thy mind;
All pains, all cares, may favouring Heaven remove,
All but the sweet solicitudes of love!
May powerful nature join with grateful art,
To point each glance, and force it to the heart!
O then, when conquer'd crowds confess thy sway,
When ev'n proud wealth and prouder wit obey,
My fair, be mindful of the mighty trust:
Alas! 'tis hard for beauty to be just. . . .

In the first you recognize the light rhythm, alliteration, and pretty jingles so characteristic of Tennyson, and in the second the ponderous periods of Sam Johnson and his predilection for big words. What could be more Johnsonese than the line "all but the sweet solicitudes of love"? Or than the adage with which the verse ends: "Alas! 'tis hard for beauty to be just"? Johnson's writings and his conversation throughout his life were peppered with adages borrowed or improvised.

The early interests and displays of special talent by Cox's subjects were often disregarded in the vocational guidance given them by parents and teachers. In no less than 20 of the 100 cases whose childhood is best known there was pressure to turn the subject into another field than that in which eminence was achieved. The destiny that half of these had to escape was the legal profession. Balzac's parents tried for five years to starve him into submission that they might make a lawyer of him. Dumas (*père*) was first destined for a military career, later for the priesthood and was finally apprenticed to a notary. When Victor Hugo was 19 his father offered him an allowance if he would relinquish literature for a more substantial profession. Victor preferred to live in a garret and write. Coleridge's father wanted his son to be a parson, but fortunately the father died and the boy was reared by an uncle who recognized literary genius when he saw it.

The guidance of gifted children is made more difficult by their versatility. Intellect by its very nature is highly general, and it follows that to one who is intellectually superior many fields of achievement are possible if the requisite interests and drives are present. The versatility of a few geniuses has received considerable attention, but the less spectacular cases are overlooked. People like to believe that the genius as a rule is no better than the rest of us except in one particular. The facts are very different. Except in music and the arts, which draw heavily on specialized abilities, there are few persons who have achieved great eminence in one field without displaying more than average ability in one or more other fields.

A few years ago, one of my students, Ralph K. White, made a study of the versatility of Cox's 300 geniuses.[3] Using the biographical information assembled by Cox, White and another psychologist rated each subject on the ability shown in 23 different fields. The results indicated that a majority of the subjects displayed more than ordinary ability in 5 to 10 fields. The mean versatility index was highest for non-fictional writers, statesmen and philosophers (around 7.5); somewhat lower for scholars, religious leaders, scientists, poets, mathematicians, novelists and dramatists (around 6.7); much lower for soldiers and artists (4.3 and 4.0), and lowest of all for musicians (only 2.7).

White further analyzed his ratings to see what abilities tended to appear together. It was found, for example, that science, mathematics, invention and handwork form a rather closely-knit group; poetry, novels and drama another. Philosophy, social theory, history and languages form a third but less compact structure. Religious leadership is allied with politics and administration, while musicians stand pretty much alone. One of the most interesting relationships is that between art and the science cluster. Leonardo da Vinci is here the supreme example.

Another approach to the biography of genius is by way of psychoanalysis, which investigates the motivational dynamics that shape the individual personality. The contributions from this direction now make up a vast literature difficult to appraise. To any but the most orthodox Freudian much of it will appear highly extravagant and far fetched. Some of the contributions, however, appeal to the psychologist as in line with common observation. One does not have to accept the elaborate superstructure of symbolism erected by Freud to be convinced that psychoanalysis has profoundly influenced modern theories of personality. There are few psychologists who longer doubt that the crucial influences shaping the lives of some persons stem from their childhood experiences: for example, from parent-child conflicts or attachments, from sibling relationships, from the sense of not being wanted or from frustration in its myriad forms. It is impossible to understand the unsexed personality of John Ruskin without knowledge of his parental attachments, the rebellious spirit of Lord Byron without knowledge of his deformity and of his maternal conflicts, or the messiah complex of John Wesley without knowledge of the mother-inspired ideal to which he was molded by family pressures. The phenomenon called Hitler surely is not to be explained in terms of extraordinary intellectual endowment, but rather in terms of personal frustrations, displaced hatreds and fanatical aggressions.

I believe there is factual basis for Lasswell's suggestion that the role of rebel or agitator is sometimes only a continuation of the child's fight against parental tyranny. Emma Goldman, with psychological insight unusual in autobiographies, calls attention to the possible relationship between her career as anarchist and the brutalities she suffered from her father in childhood; she did not think it accidental that one of her foremost associates among the anarchists had a similar background of domestic tyranny.

Lange-Eichbaum, a German psychiatrist, has emphasized the importance of inner conflicts and tensions of whatever kind as stimulants to great achievement. he believes that without such irritants no one ever puts forth his maximum effort; that the personality happily adjusted to its environment and never stirred to action by opposition or frustration is foredoomed to obscurity. Examining from a psychiatric point of view the lives of a large group of historical geniuses this author concludes that the more eminent the subject the more marked the evidence of inner conflict bordering on the psychopathic. One would like to see this conclusion checked by a research commission composed of historians, psychiatrists and psychologists working with an objectively selected population.

In evaluation of these various approaches to the study of historical geniuses I wish to go on record as believing that all of them have merit enough to justify their further cultivation. At the same time, any one who has attempted to draw conclusions from the fragmentary information that can be gleaned from biograpical works is painfully aware of the limitations of his material. One's interpretations are at best only tentative and suggestive, lacking always the finality of positive proof. It is a relief, accordingly, to turn to the investigation of living subjects who may be studied firsthand at successive age levels with unlimited opportunity for correlating factual data in the individual's life history.

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[3] Ralph K. White, *Jour. Social Psychol.*, 460–489, 1931.

II

By the study and follow-up of intellectually superior children we can find out what such individuals are really like in early life and what kind of men and women they become. Data which I had been able to secure from tests and observations of about 100 gifted children between 1910 and 1920 suggested that many of the traditional beliefs on these points contained a preponderant element of superstition. It was obvious, however, that to secure anything like conclusive evidence would require an expensive study of a large and representative group of subjects.

By good fortune a grant was obtained from the Commonwealth Fund for an investigation of the desired scope. In 1922 a school population of more than a quarter of a million was sifted by methods which brought to light practically all the children capable of earning an IQ of 140 or higher, a score that is attained by only five or six children in a thousand. More than 1000 subjects of this degree of intellectual superiority were located in the elementary grades and about 300 in high schools, a population large enough to yield reliable statistical constants and sufficiently free from sampling bias to provide a sound basis for generalization. What is true of this group should be true of any similarly selected group in any comparable culture.

Let it again be noted that the gifted child is here arbitrarily defined as one whose score in tested intelligence is equalled by about one child in two hundred of the school population. Obviously the term *genius* can be applied to subjects of this grade of mental superiority only in a very liberal sense. The population studied by Galton was twenty times as highly selected, since it included only the most eminent in 4000 of the generality. The American "Who's Who" population is ten or twelve times as highly selected as my gifted group, and Cattell's galaxy of 1000 starred scientists is several hundred times as aristocratic. It is necessary to hold these comparative figures in mind in order to appraise justly the life achievements of the subjects I have studied.

The data secured for this group in 1922 include for a majority of the subjects two intelligence scores; twelve scores from a four-hour test of school achievement; scores from three tests of character, personality and interests; 34 anthropometric measurements; the results of a one-hour medical examination; ratings by parents and teachers on 25 personality traits; and a large amount of case-history information supplied by parents, teachers and field assistants. What is the gifted child like when we find him?

The medical examination and anthropometric measurements showed the typical gifted child physically superior to the average. The tests of personality and character yielded scores far superior to those of average children of corresponding age. In school achievement the gifted subjects scored almost as high as in IQ. A majority of them had in fact acquired a good mastery of the curriculum as far as two, three or even four school grades beyond that in which they were enrolled.

Marked unevenness in achievement was rare. Whereas the mean intelligence quotient of the group was about 150, the mean achievement quotients in reading, arithmetic, language usage, spelling, science information, literary information, historical information, and aesthetic information, were all in the narrow range between 137 and 152. The relative uniformity of these average scores establishes beyond question that a high degree of versatility is the rule in a group of this kind.

This is where our biographical study of gifted children began in 1922. It has now been under way long enough to give some indication of the probable life achievement of such a group. The thousand who were below high school age in 1922 now range from 22 to 32 years, with a median of about 27. The 1922 high school subjects range from 29 to 37, with a median of 33. I am still in contact with more than 95 per cent. of the original group.

For several years after 1922 the subjects were followed by information blanks that were filled out and mailed to me annually by the parents and teachers. In 1928 a second grant from the Commonwealth Fund made it possible to have field assistants retest most of the subjects and obtain a large amount of additional information through interviews with parents, teachers and the subjects themselves. The next follow-up was conducted chiefly by mail in 1936–37, but a liberal grant from the Carnegie Corporation a year ago has made it possible to keep three research associates in the field since last September testing and interviewing the subjects. As not all of the new data have yet been statisticised, most of the figures I shall report will be in round numbers subject to later corrections that will not materially affect the picture.

First a few vital statistics. The mortality rate of the group to date is below that of the generality of corresponding age. The same is true of the insanity rate. The incidence of suicide approaches more closely that of the generality.

At the present time nearly two thirds of the members of the group are or have been married, the proportion being about the same for men and women. The divorce rate is below that of the generality in California of corresponding age. Among those who have married, 40 per cent. of the men and 50 per cent. of the women married college graduates. The mean intelligence score of the subjects themselves is well above that of their spouses, but the latter also test high.

The group has thus far produced about 500 offspring. Tests given recently to 300 of these who are above the age of two years have yielded a mean IQ of approximately 127, which represents about the expected regression toward the mean of the generality.

Has the intellectual superiority shown by this group in 1922 been maintained? In terms of intelligence test scores the answer is emphatically yes. The retests given both in 1928 and during the past year showed a majority of the subjects close to the 99th percentile of the generality. This is true even of those whose careers have not been particularly successful. Although there are exceptions to the rule, the intellectually gifted individual can be identified almost as accurately in the third elementary grade as at age 30.

With regard to educational achievement, the average member of the group enters high school at 13 and college at 17. Nearly 90 per cent. enter college and of those entering about 93 per cent. graduate. Although averaging nearly two years younger than their classmates, they engage more extensively in extracurricular activities, receive more student-body honors and are several times as likely to graduate with distinction.

Approximately two thirds of the men who graduate, and half of the women, go on for graduate work. Of some 300 men who have completed their graduate studies, about 50 have received a Ph.D. degree, about the same number a medical degree, about 85 a law degree, and about 35 a degree in engineering or architecture. Less than one tenth as many women as men have obtained a graduate degree beyond the M.A. For the sexes combined the incidence of higher professional degrees is perhaps twenty or thirty times as great as for the general population.

In appraising the life achievements of these subjects it is necessary to take account of the severe economic depression that has spanned most or all of their adult years. This circumstance has made harder the way of many and has diverted some permanently from their educational goals.

The averaged earned income of the men at age 30 is around $3,000 a year. About a dozen of the men are earning between $10,000 and $15,000 a year. In general, the women who are gainfully employed earn only about half as much as the men, and the maximum reached by women is only about one fifth the maximum for men. Income, however, is a poor measure of achievement, particularly in the case of young men just starting on their professional careers. Some of the most promising members of the group are at present earning less than $2500 a year.

Turning to other indications of achievement we find that about 50 of the men and a dozen of the women are teaching in colleges or universities. Seven of these are already executive heads of departments.

Publications by the total group number hundreds of articles in professional or technical journals, at least 20 books, and a vast number of short stories, popular articles and poems. The books include textbooks, scholarly treatises, a semi-popular book on invention, five volumes of fiction and two books of poems. Eighty or more patents have been issued to men of the group, none to any of the women.

As a relief from impersonal statistics I will cite briefly a few examples of individual accomplishment. The list could be multiplied many times in length.

1. A professor in one of the physical sciences and head of his department in a great university. Has published three text-books, more than 50 research articles, and has taken out more than a score of patents. Well known nationally and internationally.

2. A professor of physiology in a state university and head of his department. Has devised new techniques for heart diagnosis which he has been called upon to demonstrate in leading medical schools of this and other countries. At the age of 36 has 52 publications to his credit.

3. A brilliant student who took his master's degree at 20 in classical literature, then turned to business and at 27 became chief investment analyst for a forty million dollar educational foundation.

4. A musical composer of international reputation, nurtured in poverty and totally unschooled until the age of 17. He is the author of three books and dozens of articles on musical theory. In the last three years alone he has composed 60 major orchestral works, written a book on melody and learned two foreign languages.

5. An aeronautical engineer who at 32 is coordinator of research in a ten million dollar aeronautical laboratory.

6. An artist in the middle twenties who is an important member of Walt Disney's staff with a salary of $1000 a month.

7. A woman who has shown exceptional talent in several fields. Between the ages of 7 and 15 she wrote a vast quantity of poetry, some of which was rated by professors of English as equal to the best juvenilia of eminent English poets. After graduating from college at 17 she wrote a novel, studied painting for a time, then turned to sculpture and was for three years the sole pupil of one of the best known sculptors in Europe. She bids fair to become eminent in this field.

8. A woman of 28 who has a Ph.D. degree of English and has published a volume of poetry that won high praise from critics. Like Number 7, she began writing poetry in early childhood and produced several juvenilia that compare favorably with those of eminent authors.

9. A woman who was awarded the degree of doctor of science by the Pasteur Institute at age 25 and is engaged in medical research.

10. A woman who received the A.B. degree in engineering at 19, a graduate degree in mining engineering at 21, and a doctorate in metallurgy at 24. She is assistant to the director of a research laboratory of a large steel firm.

We have seen in the case of historical geniuses that the direction of adult accomplishment is often foreshadowed during the early years. In order to find whether this is true of my gifted group the records of men in the various fields are being compared with respect to childhood hobbies, school marks, achievement test scores, amount and kinds of early reading, trait ratings by parents and teachers, early social adjustment and other variables. Although the analysis has not been completed, the data are showing more than chance agreement between some of these variables and the field of adult achievement. This is particularly true of those who have accomplished the most. Achievement in music, literature and art is almost always foreshadowed in some degree.

The range of success in my group is very wide for both sexes and at the present time extends downward to occupations as humble as those of policeman, carpenter, gardener, gas station operator, department store floor-walker, store clerk, house-to-house canvasser, small rancher, seaman, telephone operator, typist and filing clerk. The question arises what factors other than intelligence are important determiners of achievement in such a group.

One, obviously, is sex. Although the women equal or excel the men in school achievement from the first grade through college, after school days are over the great majority cease to compete with men in the world's work. If they do not marry at once they accept whatever kind of respectable employment is at hand. After marriage they fall into the domestic role and only in exceptional cases seek other outlet for their talents. The woman who is a potential poet, novelist, lawyer, physician or scientist usually gives up any professional ambition she may have had and devotes herself to home, husband and children. The exclusive devotion of women to domestic pursuits robs the arts and sciences of a large fraction of the genius that might otherwise be dedicated to them. My data strongly suggest that this loss must be debited to motivational causes and to limitations of opportunity rather than to lack of ability.

Since the achievement of women is so largely determined by extraneous circumstances and is in any case so difficult to estimate, my investigation of the causes of success and failure has been confined to the male group. Three psychologists, working independently, examined the records of 600 men and rated each subject on life success. The criterion of "success" was the extent to which a subject had made use of his superior intellectual ability. The judges were instructed to give very little weight to earned income.

On the basis of these ratings the men were tentatively classified into three groups, composing roughly the highest fourth, the middle 50 per cent. and the lowest fourth. The highest and lowest fourths, or the A and C groups as we have called them, were then compared with respect to test scores of 1922 and 1928, family records, home environment, case histories, health data, trait ratings and many other items of information, in the hope that by reading the records backwards, so to speak, some light might be thrown on the factors that influence achievement.

The educational and occupational records of these two groups present a vivid contrast. Of the A's, 98 per cent. entered college and 90 per cent. graduated; of the C's, 70 per cent. entered and only 50 per cent. graduated. Three fourths of the A's but only a fifth of the C's completed one or more years of graduate work. Among those graduating, nearly one half the A's but only 4 per cent. of the C's were elected to Phi Beta Kappa or Sigma Xi. Half of the A's but only 10 per cent. of the C's had received appointment to scholarships, fellowship or assistantships. In professional or semi-professional pursuits were 96 per cent. of the A's as compared with 28 per cent. of the C's. Although salary had been given little weight in the success ratings, the average earned income of the A's was two and a third times that of the C's.

Let us turn next to the childhood records and test scores of the two groups to see what facts or circumstances are associated with differences in life accomplishment. We note first that during the elementary school years the A's and C's were about equally successful. Their average grades were almost identical, and the average scores on a four-hour achievement test were only a trifle higher for the A group. In high school the groups began to draw apart as a result of lower grades in group C, but it was not until the college period that the slump of this group assumed alarming proportions. The slump can not be blamed upon extra-curricular activities, for these were almost twice as common among the A's as among the C's. Nor can it be attributed to intellectual deterioration, for on every mental test, from 1922 to 1940, the average score of the C's has been only a few points lower than that of the A's. In a population so highly selected for intelligence that each person in its rates within the top one per cent. of the generality, the differences in success must necessarily be due chiefly to non-intellectual factors.

For one thing, the family backgrounds of the two groups differed markedly. Nearly twice as many A parents as C parents had graduated from college, and a similar difference was found between the siblings of A's and C's. Fathers of the A's were far more often in the professional classes. The important point here is that the educational tradition was stronger in families of the A group. In line with this is the fact that the Jewish element is three times as large among the A's as among the C's. The Jewish child is under heavy pressure to succeed, with the result that he accomplishes more per unit of intelligence than do children of any other racial stock.

Significant differences between the groups were found in the childhood data on emotional stability, social adjustments and various traits of personality. The case histories and trait ratings obtained from parents and teachers in 1922 reflect these differences clearly. All the 1922 trait ratings except those for health averaged lower for the C group. That is, fifteen or more years prior to the classification of these subjects on the basis of adult achievement, teachers and parents had been able to discern personality differences that would later characterize the two groups.

The A-C differences are further evidenced in the marital records. The incidence of marriage is higher in the A group and the age of marriage is lower. Moreover, the A's marry better than the C's; the A spouses score higher in intelligence tests and include nearly twice as large a proportion of college graduates. Especially significant is the contrast in marital adjustments, for the incidence of separation or divorce is only a third as high in the A group as in the C group. This difference extends even to the parents of the two groups, the incidence of separation or divorce being only half as great for A parents as for C parents.

The A-C differences in marital adjustments appear to be symptomatic of more basic differences in emotional stability and integration of personality. With the aid of funds from the National Research Council a special study is being made of marital adjustments in the entire gifted population. This has shown that the A group scores higher than the C group not only in present marital happiness, but also higher in a test designed to measure general happiness of temperament, or what might be called aptitude for happiness.

The facts just reported appear to be in direct opposition to the Lange-Eichbaum theory that great achievement is associated with emotional tensions which border on the abnormal. In my gifted group success is associated with emotional stability rather than instability, with absence rather than presence of disturbing conflicts, with happiness of temperament and with freedom from excessive frustration. This does not necessarily mean that the Lange-Eichbaum theory has been disproved. It is conceivable that the personality factors which make for ordinary achievement under ordinary conditions are different from those which make for eminence of a superlative order. The two approaches agree in the conclusion that beyond a certain high level of intellectual ability success is largely determined by non-intellectual factors and that the number of persons who are endowed with abilities equal to great achievement is immensely greater than the number who will attain eminence.

Looking forward to the future, I regard it as unlikely that more than a few score of my 1,300 subjects will attain to a national reputation or that more than a dozen or so will become really eminent. It would be surprising if even one of them a hundred years hence should be found among the thousand most eminent persons of history. In sheer intellectual ability, however, I am sure that my group overlaps Cattell's thousand most eminent persons of history. Although the group certainly contains no intellect at all comparable with that of a Newton or Shakespeare, I believe it contains many who are intellectual equals of Washington, the nineteenth most eminent in Cattell's list, and perhaps some who are not intellectually inferior to Napoleon, the most eminent man of all time.

These specific estimates are of course not amenable to objective proof. They are offered merely as illustrations of a larger truth that no one can doubt who has studied either a group of historical persons or a group of living gifted subjects: namely, that genius and eminence are far from perfectly correlated. Why they are so poorly correlated, what circumstances affect the fruition of human talent, are questions of such transcendent importance that they should be investigated by every method that promises the slightest reduction of our present ignorance. So little do we know about our available supply of potential genius; the environmental factors that favor or hinder its expression; the emotional compulsions that give it dynamic quality; or the personality distortions that make it dangerous! And viewing the present crisis in world affairs who can doubt that these things may decide the fate of a civilization?

THE TIME CAPSULE[1]

By DAVID S. YOUNGHOLM
VICE-PRESIDENT OF THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY

WE are gathered here together to-day to take part in a ceremony that, so far as I know, is unique in history. We are the people who will be the last of our time to see the 800-pound letter to the future, which was posted at this point two years ago and which will now be sealed and sent on its journey into the ages to come.

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[1] Address on the occasion of the sealing-in of the Time Capsule of the Westinghouse Electric and Manufacturing Company on the grounds of the World's Fair, September 23, 1940.

In a few minutes we expect to complete the sealing-in ceremony, which will be the last act of our generation in preparing the Time Capsule as a message for historians of the future.

At the bottom of this "Immortal Well," which goes 50 feet into the earth beneath the walls of the Westinghouse Building at the New York World's Fair, the world's first Time Capsule is about to begin its long journey into the future—a journey which, it is hoped, will extend through 5,000 years of time.

The Time Capsule is something like the imaginary "time machine" described for us by H. G. Wells, except that the Time Capsule can not hasten forward through time—it can only wait. For this purpose we have fashioned it with care, and we believe it is amply protected to remain safely in the soil—not 5,000 years, but perhaps as long as 15,000—if need be.

The Time Capsule represents months of careful planning and the combined efforts of hundreds of persons. Archeologists, historians, engineers, librarians, scholars and many others were consulted at every step so that the project might be as nearly successful as all our present-day arts and sciences could make it.

Leaving a message from our time to so distant a future presented three distinct problems: First, how to build a vessel capable of preserving the record; second, the selection and preservation of the objects to be included; and third, how to leave word of its whereabouts for future historians.

The capsule, as finally constructed, consists of a one-inch outer shell of cupaloy (chosen because of its electrical qualities and resistance to corrosion). It was cast in sections; each section threaded and screwed into the next and sealed in with asphalt.

The contents of the torpedo-shaped capsule were packed securely in an inner envelope of Pyrex glass, which was then sealed, evacuated, filled with nitrogen and set into the shell in waterproof mastic. The inner crypt is about six and a half inches in diameter and seven feet long.

More than 40 articles of common use are included. Among them are a fountain pen and mechanical pencil, a watch, an electric lamp, a tobacco pouch with zipper, tobacco, pipe, cigarettes, cosmetics, a woman's hat, eyeglasses, toothbrush and powder, a miniature camera and film, a razor, a can opener, specimens of our money, and so on. There are samples of the major metals and alloys; textiles, including wool, cotton, silk, linen, rayon, glass fabrics, rubber fabrics, asbestos cloth; materials such as Portland cement, asbestos, synthetic and natural rubber, synthetic plastics; also samples of coal (which may be rare in 5,000 years), seeds of staple food crops and many other items.

Most important is a carefully prepared microfilm "essay" on our times, taken from books, almanacs, pictures, arranged in logical order to cover all the major activities of human life. Multi-lingual texts, a dictionary and an idiomatic lexicon will enable future historians readily to translate the texts of the microfilm. All film in the capsule is cellulose acetate especially prepared for permanence. The microfilm contains a total of more than 23,000 ordinary book pages, reproducing more than 10,000,000 words, and many hundreds of pictures. A microscope is enclosed to enable "futurians" to read the text. Complete directions in text and picture are given for the construction of a larger reading machine and a motion picture projection machine.

For use with the latter, a newsreel is enclosed, specially prepared for the people of A.D. 6939. This contains nearly a score of historic, typical or significant scenes of our day, with sound.

Word has been left for future archeologists in the form of a Book of Record, printed with specially compounded permanent inks, on 100 per cent. rag permanent book paper. Copies have been sent to libraries, museums and other repositories throughout the world. Some will surely survive, either in the original form or translated into new languages that arise. In this respect we have the example of the Egyptian papyrus, a paper-like material that has lasted, without special protection, for many hundreds of years.

In order that futurians may know when the year 6939 has come, the equivalent of this date is given in the book not only in our own calendar, but also in the Chinese, Jewish, Mohammedan and Shinto calendars. If none of these kinds of calendars survives, futurians may still calculate the years elapsed by reckoning from astronomical data supplied by the United States Naval Observatory. These include the number and dates of eclipses of the sun and moon in 1939, the positions of the planets and the angle of the earth's pole relative to the north star.

The U. S. Coast and Geodetic Survey has provided a description of the survey's network of stations across the United States, astronomical and geodetic locations of nearby permanent stations, and the exact latitude and longitude of the Time Capsule, determined by a special survey. Given to the third decimal point in seconds, these geodetic coordinates are sufficiently accurate to locate the spot with an error of less than an inch. They are: Latitude 40° 44′ 34″ .089 north of the Equator; Longitude 73° 50′ 43″ .842 west of Greenwich.

If other guides fail, the futurians can still find the capsule. Minute directions have been prepared for constructing and using electromagnetic instruments to locate it by the methods widely used to-day.

Finally, that our language may not be lost, the book contains a simple but ingenious key to English which will permit readers to translate our tongue and to pronounce it, 1938 style, as well. This was prepared by Dr. John T. Harrington, of the Smithsonian Institution, and has caused much comment and interest among students of our language.

It is impossible, of course, to detail here all the studies and reasoning which led to the construction of the Time Capsule and selection of its contents. We have undertaken with humility the enormous task of leaving this message to the future, realizing well that no selection of ideas and materials, no matter how large, could really do justice to the astonishing variety and vigor of our age. Whether, in the end, the project can achieve its purpose depends on ourselves and our posterity. The engineering difficulties of removing the Time Capsule from its resting place can probably be counted upon to protect the capsule from vandalism. We feel that the good instincts of the human race may be relied upon to preserve word of its whereabouts for the generation to whom it is addressed.

We are often asked whether the Time Capsule will not be beneath the ocean when 5,000 years have elapsed. This question is raised because there is a general belief that the eastern coast of the United States is slowly sinking, and that as a result the ocean will rise higher and higher, finally covering these parts. The best answer to that comes from the U. S. Coast and Geodetic Survey, which has repeatedly surveyed bench marks along the Atlantic coast. They tell us that no evidence can be found that the coast is either rising or sinking. If it should be sinking, the rate of motion must be as slow as an inch a century, or else the sensitive instruments would long ago have detected it. At the rate of an inch a century, 5,000 years would see a sinking of only about four and a half feet. Since we are at this point 25 or more feet above sea level, we feel that the capsule will be safe from the ocean during its appointed time.

In addition to all the other protections that have been thrown around the Time Capsule, we are now about to place one more. The capsule rests at the bottom of a well which was made by driving a twelve-inch pipe into the soil until it reached solid ground at the bottom. Inside that pipe a ten-inch steel pipe has been welded. The second pipe was inserted in order that the well might remain dry. At the bottom of the inner pipe has been placed a three-foot plug of waterproof concrete and two feet of sand mixed with tar. The Time Capsule, at present, rests upon this base. Last night, in preparation for this ceremony, the capsule was straightened up and a small layer of our sealing material was poured around the bottom to hold it upright in the pipe. We shall presently pour in upon the Time Capsule 500 pounds more of this material, a substance consisting of 58 per cent. petroleum pitch, 17 per cent. chlorinated diphenyl, and 25 per cent. mineral oil. This material has been specially chosen because of its resistance to electrolysis and other characteristics. Our engineers tell us that this compound alone should last for thousands of years. All the materials used have been made from coal or oil products which were in the earth for millions of years before they were put to work.

Thus, when this sealing-in is performed, the Time Capsule will be protected from the earth and elements by two thicknesses of steel pipe and an inch layer of highly resistant plastic. Even without these protections, our engineers believe that the Time Capsule would be quite capable of lasting more than 5,000 years safely. With this additional protection, its potential life will be greatly prolonged.

SCIENTIFIC EVENTS

THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

THE fifth annual "Progress Report" of the Society for the Promotion of Engineering Education was released by Professor C. F. Scott, chairman of the committee, prior to the Berkeley meeting in June. The report is based on about sixty letters from officers and chairmen of the society. Items indicating progress were selected, condensed and epitomized.

The report states that increase in enrolment is significant, undergraduate students in approximately 150 engineering schools in the United States and Canada now numbering about 106,000, an increase of nearly 30 per cent. in three years. There were in 1939 4,700 candidates for the master's degree and for the doctor's degree 850, both having more than doubled in three years. The report states that this "undergraduate increase is presumably due partly to the employment situation, but mainly to the growing regard for engineering training as a preparation for careers in industry, business and public service." Mechanical engineering enrolment, which shows the greatest increase during this period, 89 per cent., "may be traced to the character of this curriculum and to the recent publicity given to aeronautics, Diesel engines and air-conditioning. Most mechanical engineering curricula stress management and labor problems, which may be an added explanation."

It is pointed out that "a notable trend in engineering education has been in the field of chemical engineering, which is maturing rapidly, and becoming more and more a mathematical, quantitative kind of engineering; its technical literature is growing; the quality of instruction and the physical facilities of the schools are improving; and a younger generation of teachers is putting it across."

After recounting the advances being made by engineering schools in the teaching of physics, English, aeronautics, surveying, geodesy, mathematics, hydraulics and fluid mechanics attention is called to the subject of research. The report states that "prior to 1933 over half of new process and new product development came from Central Europe; in 1938, less than five per cent. Totalitarian influence on education is forcing American industry to a new dependence on research carried out in the United States."

The committee on aims and scope of engineering curricula in its contribution to the report presents the new conditions, trends and attitudes which necessitate a new study of the subject; it specifies objectives and stresses the fact that the normal basic course should prepare engineers for a wide range of technical, administrative and executive responsibilities. Some of the views it has considered include (a) the lengthening of the undergraduate curriculum to five or six years, (b) requirement of a period of preliminary study in a school of liberal arts preceding admission to the school of engineering, and (c) the trend in the direction of dividing the curriculum in the junior and senior stages.

The past year brought to completion the second stage in the accrediting program of the Committee on Engineering Schools of the Engineers' Council for Professional Development, of which the Society for the Promotion of Engineering Education is a member body. The first stage had to do with organizing the program of inspection and with developing principles and procedures. The second stage involved carrying these plans into operation. Consequently, there is available to-day an essentially complete list of accredited curricula of the engineering schools of the country for the guidance and use of state licensing boards for engineers, the national engineering societies and the thousands of high-school students contemplating an engineering career. A by-product of the investigations incident to accrediting is the interchange of information which has given opportunity for all schools, large as well as small, to improve their educational programs.

GRADUATE WORK IN CHEMISTRY AT COLUMBIA UNIVERSITY

THE adoption of a new program of studies leading to the degree of doctor of philosophy in chemistry at Columbia University has been announced by Professor Harold C. Urey, head of the department of chemistry.

Under the new system students need not enrol in a definite number of formal courses, although they are expected to register in certain classes in order to prepare for their dissertation and examinations. Hitherto candidates for the Ph.D. have followed a prescribed curriculum in much the same manner as undergraduates. Provision has also been made for greater financial assistance to those undertaking graduate work in chemistry.

The new program has been made possible through arrangements put into effect last year for exercising a greater selectivity in admitting graduate students and limiting the number matriculated for a Ph.D. degree. Students who wish to matriculate for the degree are advised that full-time rather than part-time work is desirable under the new plan. The following regulations have been made:

> In order to become candidates for the degree, students are now required to pass a matriculation examination after one full year of graduate work. Their acceptance will be based largely on the result of the examination and not upon any accumulation of undergraduate and graduate credits.
>
> Candidates will also be required to have a good reading knowledge of both French and German. Within one year after being accepted they must submit to the faculty three theses, each containing an original conclusion drawn from reading and laboratory work. These theses must be defended before an examining board comprised of faculty members in the department.
>
> The final awarding of the degree will depend upon an exhaustive dissertation prepared by the student on some original research project. The dissertation must be submitted for approval to a committee composed of members of the faculty of pure science. Although a limit has not been imposed upon the length of time necessary to carry out the research, the fact that the great majority of those accepted in the future will be students who will devote full time to their studies will automatically reduce the average time required to obtain a Ph.D. degree.

In describing the plan Dr. Urey said:

> Plans have been made to increase the amount of assistance given by the department to properly qualified students who are unable to continue graduate work without financial aid. Formerly students who were awarded teaching assistantships paying $1,000 for the academic year were required to teach twenty-four hours a week. Under the new plan this has been reduced to sixteen hours. As a result of lowering the number of teaching hours required, there has been a decided improvement in the caliber of those applying for assistantships. It was found possible to accept only a fraction of the number of excellent students who requested such aid this year.
>
> In building an outstanding graduate department it is as necessary to have a strong student body as it is to have an adequate faculty. However, despite the presence of the latter, the department can not attract competent graduate students unless a proper amount of financial support is offered by the university.

SURVEY OF THE FLORA OF GUATEMALA

A botanical expedition to survey the flora of Guatemala for the Field Museum of Natural History, Chicago, will be conducted during the next seven months by Paul C. Standley, curator of the herbarium. Mr. Standley left Chicago on September 30 to board the steamship *Zacapa* at New Orleans for Puerto Barrios. The expedition will continue explorations conducted by a similar expedition which he led in 1938–39, and an expedition conducted by Julian A. Steyermark, assistant curator of the herbarium, in the early part of 1940. The ultimate purpose of the work of all three expeditions is the preparation of a descriptive and illustrated account of the plants of Guatemala, to be published by the Field Museum Press.

The plant life of Guatemala is more varied than that of any other country of Central America, and quite possibly richer in number of species. In spite of intensive work by the previous Field Museum expeditions, there still remain important areas of the country whose flora have not yet been investigated, due to the exceedingly varied topographical features. Some regions, such as the great Department of Peten whence comes much of the chicle used in a Chicago industry, are so difficult of access that their flora is not likely to be well explored for many years. However, the government at present is extending a long road into Peten, so that during the coming winter it may be possible to reach even that region by automobile.

The present expedition is leaving early in the season in order to reach Guatemala before the summer rains and their effects have ended. The country has approximately six wet and six dry months, the latter coinciding with the autumn and winter of the north. In many parts of the country there always is sufficient moisture to support a continuous abundance of growing plants, but in other parts the vegetation during winter months is almost as greatly reduced as in the United States. It is necessary to visit these areas before too many of the plants have been killed by cold and drouth. After they have been worked as long as seems advisable, collecting will be continued in moister regions, such as the Pacific Coast and the rain forests of Alta Verapaz, the centers of coffee production.

It is expected that the present expedition will obtain species new to science, and others that have never been recorded before from Guatemala. Thus data will be provided for completing the descriptive account of the plant life of this relatively small but highly varied and exceptionally interesting country.

APPOINTMENTS AT THE MEDICAL SCHOOL OF THE UNIVERSITY OF MINNESOTA

The following changes have been announced in the Medical School of the University of Minnesota:

Dr. J. Frank Corbett retired July 1, 1940, from the faculty as clinical professor of surgery in the Division of Neurosurgery. Dr. Corbett was made clinical professor emeritus of surgery.

Dr. Lemen J. Wells, formerly of the University of Missouri, has been appointed associate professor of anatomy.

Dr. Charlotte M. Gast has been appointed assistant professor and assistant director of the course in medical technology.

Dr. Edwin S. Fetcher, formerly of the University of Chicago, and Dr. Robert B. Dean, of the University of Rochester, have been appointed instructors in the department of physiology.

The following promotions have been announced:

Dr. Halvor O. Halvorson has been made professor of bacteriology; Dr. Raymond N. Bieter, professor of pharmacology; Dr. William A. O'Brien, professor of preventive medicine and public health and director of postgraduate medical education; Dr. Cecil J. Watson, professor of medicine and director of the Division of Internal Medicine; Dr. William T. Peyton, professor of surgery and director of the Division of Neurosurgery; Dr. George O. Burr, professor of botany and of physiology, has in addition been appointed director of the Division of Physiological Chemistry.

Dr. Arthur C. Kerkhof has been promoted to clinical associate professor of medicine; Dr. Starke Hathaway to clinical psychologist and associate professor of nervous and mental diseases; Dr. James B. Carey to clinical associate professor of medicine, and Dr. Wallace D. Armstrong to associate professor of physiology and director of biological research in dentistry.

THE MOUNT DESERT ISLAND BIOLOGICAL LABORATORY

The Mount Desert Island Biological Laboratory officially closed its 1940 season on September 15.

At the annual meeting of the corporation held on August 8 the following trustees were elected to serve until 1943: William H. Cole, Robert W. Hegner, Warren H. Lewis, E. K. Marshall, Jr., David O. Rodick and Stanley J. G. Nowak. Trustees serving until 1942 are: Earl O. Butcher, Esther F. Byrnes, J. T. Halsey, C. C. Little, Dwight E. Minnich and Homer W. Smith. Those serving until 1941 are: Hermon C. Bumpus, Ulric Dahlgren, George B. Dorr, John Whitcomb, J. W. Burger and Roy Ph. Forster. David O. Rodick was elected clerk of the Corporation for 1941.

At the annual meeting of the trustees held on August 17, the following officers were elected for the ensuing year: Ulric Dahlgren, *president;* Dwight E. Minnich, *vice-president;* John Whitcomb, *treasurer;* and J. W. Burger, *secretary.* William H. Cole, who had served for nine years as director of the laboratory, resigned and Roy Ph. Forster was elected to replace him. Homer W. Smith and William H. Cole were elected members of the executive committee to serve with the president and director of the laboratory.

Plans for the 1941 season include the construction of three new laboratory buildings, each designed to serve as a separate research unit.

RECENT DEATHS

DR. ALEXANDER S. BEGG, professor of anatomy and dean of the School of Medicine of Boston University, died on September 26 at the age of fifty-nine years.

DR. GEORGE RUTLEDGE, professor of mathematics at the Massachusetts Institute of Technology, died on September 21 at the age of fifty-eight years.

PROFESSOR JOHN E. EMSWILER, chairman of the department of mechanical engineering of the University of Michigan, died on September 23 at the age of sixty years.

DR. B. D. WILSON, professor of agronomy at the New York State College of Agriculture at Cornell University, an authority on the chemistry of peat and peat soils of northeastern United States, died from the results of an automobile accident on September 5. He was fifty-one years old.

EDWARD CHAUNCEY WORDEN, consulting chemist, who was head of the Worden Laboratory and Library at Millburn, N. J., died on September 22. He was sixty-five years old.

A CORRESPONDENT writes that the death of Joseph William Blankinship at Decoto, Calif., on July 2, 1938, professor of botany in Montana State College from 1898 to 1905, has only now become known. In later years, as a plant pathologist, Mr. Blankinship was employed by the smelter companies in Montana, Utah and northern California. In the course of his work he made extensive collections of spermatophytes in the upper Sacramento Valley, many of which are cited in Jepson's Flora of California.

CHARLES GABRIEL SELIGMAN, professor emeritus of ethnology at the University of London, died on September 19. He was sixty-seven years old.

PROFESSOR HANS ROSENBERG, an authority on astronomical photometry, former director of the Kiel Observatory and, of late, director of the Observatory at Constantinople, died on July 26 at the age of sixty-one years.

SCIENTIFIC NOTES AND NEWS

DR. FRANK B. JEWETT has resigned as president of the Bell Telephone Laboratories, in New York City, to become chairman of the Board of Directors. He will be succeeded as president of the laboratories by Dr. O. E. Buckley, who has been executive vice-president.

BECAUSE of difficulties in administration and especially in communication among the nations belonging to the International Astronomical Union the position of secretary has been taken over temporarily by Dr. Walter S. Adams, American vice-president of the union. Action to this effect has been approved by a majority of the members of the executive committee at the request of Sir Arthur Eddington, president of the union, and Dr. J. H. Oort, secretary. Communications relating to the activities of the union should now be addressed to Dr. Adams at the Mount Wilson Observatory, Pasadena, Calif.

A BANQUET was held in Chicago on September 14 in honor of Dr. Frederick B. Noyes, retiring dean of the College of Dentistry of the University of Illinois, in recognition of "his noteworthy contributions to the fields of orthodontia, dental education, dental research and organized dentistry." It was sponsored by the faculty of the College of Dentistry. The speakers included Dr. Allan G. Brodie, of the department of orthodontia of the College of Dentistry, who acted as toastmaster; Dr. Arthur Cutts Willard, president of the University of Illinois; Dr. Leroy M. S. Miner, dean of the Dental School of Harvard University; Dr. Arthur H. Merritt, immediate past-president of the American Dental Association, and Dr. Isaac Schour, president-elect of the International Association for Dental Research.

DR. HENRY B. ALLEN, secretary and director of the Franklin Institute, Philadelphia, and David Dietz, science editor of the Scripps-Howard Newspapers, have received the Goodrich award for distinguished public service.

PROFESSOR OLIVIER has been elected president of the Société Française de l'Histoire de la Médecine, Paris.

DR. EDWARD A. OLIVER, clinical professor of dermatology at Rush Medical College since 1927 and a member of the Rush faculty since 1912, has been appointed professor and chairman of the department of dermatology and syphilology at Northwestern University Medical School. He succeeds Dr. Arthur W. Stillians, who retired recently with the title of professor emeritus.

T. HOYLE LEE, graduate teaching assistant at the University of Wisconsin, has been appointed associate professor of mathematics at the University of South Carolina.

DR. HUGH J. BICKERSTAFF, associate director in the division of maternal and child health, Georgia State Department of Health, has resigned to become associate professor in public health administration at the Johns Hopkins University School of Hygiene and Public Health.

DR. ROLF ELIASSEN, assistant professor of sanitary engineering at the Armour Institute of Technology, has been appointed to succeed the late Lewis Van Carpenter as head of the Sanitary Engineering Research Laboratory with the title of associate professor. Dr. Hamilton Gray, consulting engineer, has been appointed assistant professor. He will establish and direct a new laboratory for the study of foundation soils and soil mechanics. Dr. Clair N. Sawyer, doctorate fellow in sanitary engineering at the University of Wisconsin, has become assistant professor of sanitary engineering.

DR. C. R. CARPENTER has been appointed associate professor of psychology at the Pennsylvania State College. He will continue to cooperate with the School of Tropical Medicine at San Juan, Puerto Rico, in work with the Santiago Primate Colonies, holding a nominal appointment as research associate.

DR. ELFRIEDE FREDERICK BROWN, of the Colorado State College, has been made associate professor of foods and nutrition at the Iowa State College.

DR. WALTER B. LANCASTER, ophthalmic surgeon, associate in ophthalmology at the Harvard Medical School, has been appointed chief of staff of the Eye Institute of Dartmouth College. He will take up the work on November 1.

DR. VERNE VINCENT CALDWELL, professor of psychology at the Oregon College of Education, has been appointed dean of the General Extension Division of the Oregon State System of Higher Education.

PROFESSOR M. M. RHOADES has been elected managing editor of *Genetics* in succession to Professor L. C. Dunn. Manuscripts intended for publication in *Genetics* should be sent to Editor of *Genetics*, Schermerhorn Hall, Columbia University.

DR. JOHN M. BUTLER, who recently received his doctorate in organic chemistry from the Ohio State University, has become a member of the Bakelite Corporation, Unit of Union Carbide and Carbon Corporation at Bloomfield, New Jersey.

JACK COMPTON, formerly connected with the Cellulose Laboratory of the Boyce Thompson Institute for Plant Research at Yonkers, N. Y., has become a member of the Physical Research Laboratory of the B. F. Goodrich Company, Akron, Ohio.

PHILIP C. COOKE has been appointed director of engineering and maintenance of Sharp and Dohme, Philadelphia. Dr. Willard F. Verwey has joined the staff of the Medical Research Division.

DR. FRANCIS S. SMYTH, professor of pediatrics at the Medical School of the University of California, has returned from a leave of absence which he spent in South America, part of the time in the laboratories of Professor B. A. Houssaye, of the Physiological Institute of Buenos Aires.

THE Middleton Goldsmith Lecture of the New York Pathological Society will be given at the New York Academy of Medicine on October 4 by Dr. William Cramer, of the Barnard Free Skin and Cancer Hospital, St. Louis. His subject will be "Sex Hormones and the Endocrine Balance."

TWELVE Thursday night lectures on "Cultivation of Trees and Shrubs" will be given at 7:45 at the New York Botanical Garden, Bronx Park, by P. J. van Melle, nurseryman and the horticultural writer of Poughkeepsie. This series inaugurates the autumn term of a two-year course designed for amateur gardeners. A second series, on "Cultivation of Greenhouse Plants," will begin in January and the spring term will bring a course in "Indoor Gardening Practice." A science course for professional gardeners will open, with registration at 7 P.M., on October 7.

THE autumn convention of the Electrochemical Society will be held in Ottawa, Canada, from October 2 to 5.

THE annual meeting of the Research Council on Problems of Alcohol will be held in New York City on October 15. There will be seven group conferences at 11 A.M. and a luncheon at 1 P.M.

A CONFERENCE on Nuclear Physics will be held on the occasion of the opening of the new physical laboratory of Indiana University on Friday and Saturday, October 25 and 26. Speakers at the conference and their subjects are as follows: Professor I. I. Rabi, Columbia University, "The Possibility of Measuring Spins and Magnetic Moments of Radioactive Nuclei"; Professor G. Breit, University of Wisconsin, "Formal Aspects of Resonance Theories on Nuclear Reactions"; Professor L. A. DuBridge, University of Rochester, "Some Nuclear Reactions Produced by High Energy Protons"; Professor H. A. Bethe, Cornell University, "Present Status of the Theories of Nuclear Forces"; Professor Don M. Yost, California Institute of Technology, "Studies on Vitamin B Using Radioactive Tracers"; Dr. Joseph G. Hamilton, University of California, "Tracer Studies on Biology and Medicine."

THE Production Division of the American Management Association will meet on November 12 and 13 in Cleveland to discuss manufacturing problems created by the industrial preparedness program. The sessions will be held at the Hotel Cleveland. To determine specifically the problems created for the average concern by the increased industrial tempo, the American Management Association for weeks has been in touch, through letter and questionnaire, with companies representing virtually every industry in the United States. The association reports that it finds hundreds of companies engaged in the solution of individual manufacturing problems, nearly all confronted with major problems involving personnel, methods and materials.

DR. ANTON J. CARLSON has given his library of scientific journals and monographs to the department of physiology of the University of Chicago. He became professor emeritus on October 1, having reached the age of sixty-five years. The library includes approximately sixteen thousand classified reprints of scientific articles, twelve hundred books and research monographs and complete files of fifteen scientific journals.

H. H. HSIAO, head of the department of psychology of the National Central University at Chungking, China, writes to SCIENCE under date of August 20 as follows: "Owing to the governmental control of foreign exchange, we have been out of touch with new literature in the field of psychology almost since our removal to Szechwan, but there is an increasing need for up-to-date information in our research work here. We wish that you will render us the much-needed help by sending your donations in the form of reprints, periodicals or test forms."

AT a recent special meeting of the membership the official name of the National Association of Audubon Societies was changed to the National Audubon Society. The organization, whose purpose is the protection of wild bird and animal life, was founded in 1905.

THE *Journal* of the American Medical Association reports that the biochemical division of the Bureau of Animal Industry of the U. S. Department of Agriculture has been merged with the pathologic division and the division of animal nutrition. The position of chief of the biochemical division has not been filled since the death of Robert M. Chapin. Activities of the division relating to animal diseases have been transferred to the pathologic division and those relating to the nutritive value of animal products have been assigned to the animal nutrition division at Beltsville, Md.

DR. C. STUART GAGER writes: "At a visit to the Bowdoin College Library this past summer, I was interested to find there an extensive work of some twenty volumes of illustrations in water color of the flora of Maine, by the late Kate Furbish. The sheets are somewhat larger than a standard size herbarium sheet, and are beautifully bound. They date from April, 1870, to October, 1908, and include, besides flowering plants, illustrations of about five hundred Maine mushrooms dating from May, 1897, to October, 1905. Since this is a manuscript work it occurs to me that its existence may not be generally known to systematic botanists, and others who might be interested in the flora of Maine. No public notice is known of this work, except in one of the local papers at the time the gift was made to the library, and in the annual report of the president of Bowdoin College for 1908–1909. The librarian writes me that 'Personally, I should be very glad to have the attention of botanists called to this work for strictly scientific purposes, or even for their own interest. The college should be glad to cooperate with any real botanist in the use of this work.' "

WE are requested by the Stanford University Press to state that when Volume I of Abrams's "Illustrated Flora of the Pacific States" was published in 1923 the paper stock was unsatisfactory, with the result that the pages are now rather brittle and will not stand the long handling that a reference book of this type is subjected to. As a result the edition has been reprinted on a much better quality of paper rather than distribute more of the original printing. Volume I is now printed on paper that will last indefinitely. Some necessary corrections have been made and the price of the volume has been reduced from $9.00 to $7.50. Copies of the first printing returned to the press will be credited with $3.00 on the purchase price of the new edition. Volume II of this series, describing and illustrating 1,655 species in families from Buckwheats to Kramerias will be published in December. There will be four volumes in all, rather than three as originally intended.

As reported in *Nature*, Dr. Raymond Priestley, vice-chancellor of the University of Birmingham, in the course of a circular letter addressed to headmasters of a number of schools in the Midlands, has pointed out that the age at which undergraduates will be called up for military service has been fixed by the Government at twenty years. This will enable many men to complete their university training before entering the Services. With the object of enhancing the value of such men to the national effort, it has been decided by the University of Birmingham that all future entrants will be required to choose one of the following options as part of their university course: (1) compulsory physical education for one year; or (2) two years service in the University contingent of the Officers Training Corps. Those who choose the latter will be accepted for the Officers Training Corps only if they are approved by an interviewing board set up by the Military Education Committee, the main criteria being personality and power of leadership (latent or developed). Training in the O.T.C. will be carried out with the view of developing powers of leadership rather than training technical experts. The advantages of this general military training apply equally to those taking medical and dental courses, since the military background essential to an R.A.M.C. officer can be adequately acquired in this way. Those who obtain War Certificates A and B will have definite advantages when they are called up for military service.

DISCUSSION

THE ACTIVE REGION ON THE SUN'S SURFACE

In the *Publications of the Astronomical Society of the Pacific* Volume 47, August, 1935, it was shown that for two periods of 80 solar rotations each there was a permanent region of high solar activity as shown by Wolfer's sun-spot relative numbers.

The first series of 80 solar rotations began on January 6, 1917, and ended on December 25, 1922, and the second series began on May 16, 1925, and ended on May 4, 1931. Both series gave the maximum sun-spot activity on the same day of the average rotation period of 27.25 days. The periods were separated by 872 days (32 rotation periods) in order to include the sun-spot maxima of 1917 and of 1927–28.

The Character Figures of Solar Phenomena, as given in volumes I and II of *Publications of the International Astronomical Union,* were tested in the same manner as were the sun-spots for both 80-rotation periods, and while the results were not as definite as in the case of the sun-spots, owing to the number of missing days, they were sufficiently definite to show without question that the region of maximum sun-spot activity applied to the calcium flocculi and to both the bright and dark hydrogen flocculi which accompanied the sun-spots.

Since *The Monthly Weather Review* has been publishing daily records of the area of visible sun-spots expressed in millionths of the sun's visible surface, and since we have been passing through another period of maximum sun-spot activity, it has seemed worth while to determine if the region of maximum solar activity still persists and if it may be identified by means of the areas covered by sun-spots as it was by Wolfer's sun-spot numbers.

To test this question the total areas of visible sun-spots for each day of twenty solar rotations of 27.25 days each, beginning on July 1, 1938, and ending on January 6, 1940, were arranged in successive periods and the average total sun-spot area for each day of a single solar rotation was determined. The result is indicated by Fig. 1, where the ordinates represent 1/20 of the average spot areas for each day of one solar rotation period and the abscissas represent the days of the rotation.

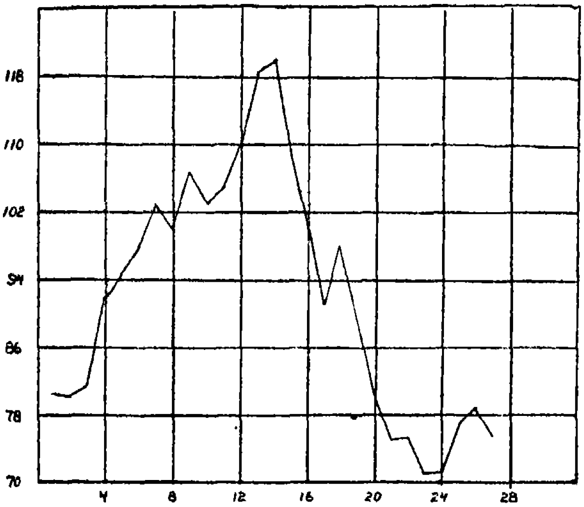

Fig. 1

The maximum sun-spot area occurred on the 14th day of the average rotation period. The date of the last maximum of the two sun-spot series referred to above occurred on May 2, 1931. From May 2, 1931, to July 14, 1940, there were 3,287 days, equaling 121 solar rotations of 27.25 days each, thus establishing the fact that the active region on the sun's disc has persisted for 23 years since January 6, 1917.

This period is certainly too long for the persistence of a single sun-spot, and during this time there have been several years without any conspicuous sun-spot.

There are also indications that it has persisted for a much longer period. For example, the great sun-spot reported by Howlett in *Monthly Notices of the Astronomical Society of London,* 1865–66; crossed the central meridian of the sun on October 13, 1865. It had an area of more than 972 million square miles. The greatest sun-spot mentioned by Maunder, which he says was the greatest for twenty years and perhaps the greatest ever recorded at Greenwich, crossed the central meridian of the sun on October 31, 1903.

Between the passage of these two great spots there were 38 years and 18 days, 13,897 days. Allowing 27.25 days to one solar rotation would give exactly 510 solar rotations between the passage of these two great spots.

From the great Howlett spot of October 13, 1865, to July 14, 1940, was 27,109 days. Assuming that there were 995 solar rotations in this period, a single rotation would require 27.245 days, lacking only 7 minutes of 27.25 days, which period has been selected as the solar rotation period of the northern sun-spot belt on the sun.

Evidently the active region on the sun's surface has persisted for more than seventy-five years.

It has been suspected for many years that there was a persistent region of high solar activity, but the apparent impossibility of the existence of such a region on a globe of incandescent gas and the difficulty of determining the rotation period of the hypothetical spot before daily sun-spot records were available rendered the acceptance of such a phenomenon very doubtful.

Professor C. A. Young, who in his book, "The Sun," page 148, has discussed the possibility that sun-spots appear repeatedly at the same point on the sun, concludes that "owing to the uncertainty of our knowledge of the true period of the sun's rotation the evidence is not sufficient to establish it. If it should be shown to be true hereafter, it would compel an entire revolution of the received view of the constitution of the sun."

FERNANDO SANFORD
PALO ALTO, CALIF.

THE ANNELID WORM, POLYDORA, AS AN OYSTER PEST

WITH the aid of a grant from the American Association for the Advancement of Science through the South Carolina Academy of Science, a study is being made of one of the numerous pests to which the commercial oyster, *Ostrea virginica*, of the Atlantic Seaboard, is subject and whose activities result in considerable financial loss to oystermen.

This particular pest is a small annelid which causes a "mud blister" in the oyster. This is a small, irregular, often pear-shaped, blister of mud, formed on the surface of the inside of the valve. The oyster covers this daub of mud with a layer of nacre. Within the blister one finds the annelid, which has access to the outside through two tunnels opening along the edge of the shell. This worm has been identified by Dr. Olga Hartman as *Polydora ciliata* (Johnston). Although *Polydora* is well known, its occurrence in such abundance as to become an oyster pest seems as yet unreported in the United States.

The worm upsets the normal life of the oyster by restricting its living space and generally weakening it. Infested oysters, although not unfit for food, are not readily salable because of their unsightly appearance.

I have had these worms and the blister they cause under observation since 1935. Indications are that the worms were prevalent in South Carolina even in precolonial days. An examination of numerous samples of South Carolina oysters shows that approximately 30 per cent. of the oysters in the state are infested with *Polydora*. The important point of the present investigation is to discover the possible underlying causes of its prevalence and its possible increasing abundance, and to determine means for its control.

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ALFRED B. NOBEL AWARDS IN SCIENCE

THE Alfred B. Nobel Prizes in five activities have been awarded since 1901. The 1939 winners were recently announced. Comparative ratings of the different countries whose citizens have received these distinctions have been made at various times, but such comparisons usually have not taken into account the relative populations of the various countries. Such comparisons are manifestly unfair since they give too low a placement to those countries of small population and too high to those of large populations.

In order to present a fairer estimate of the different countries' attainments in the sciences—chemistry, medicine and physics—they are here figured on a population basis, and where the prize was awarded to more than one person, each has been counted as a unit rather than as a fraction. Since the awarding committee could make no distinction between the winners, it seems unfair to the laureates and to their respective countries to count them otherwise than as separate winners. Counted in this manner there have been 128 laureates in the sciences listed under 16 different countries. The only Hungarian winner (in medicine and physiology in 1937) has been included with Austria since they were in that country previous to the Versailles Treaty. India and Russia have not been placed in the tables since the former has had but one prize winner and the latter only two. India would be rated last in Tables I and III; Russia next to last in Table I and last in Table II (she has had no prize winner since 1908). Dr. Charles D. Snyder in an article entitled "The Real Winners in the 1936 Olympic Games"[1] set forth the results in the Olympic Games in this manner.

The ideal quota is obtained by finding the sums of

TABLE I

CLASSIFICATION OF NOBEL WINNERS IN THE SCIENCES (1901–39) FOR COUNTRIES BASED ON POPULATION

Country	Number of winners	Ideal quota	Per cent. attainment	Comparative rank	Date of last award
Switzerland	5	1.2	417	1	1939
Denmark	4	1	400	2	1926
Holland	9	2.6	346	3	1938
Sweden	6	2	300	4	1929
Germany	37	20	185	5	1939
Great Britain ..	21	12	175	6	1937
Austria	6	5	120	7	1937
France	15	13	115	8	1935
Canada	2	3	67	9	1923
Belgium	1	2.6	40	10	1919
United States ..	15	40	38	11	1939
Italy	3	13	23	12	1938
Spain	1	8	13	13	1906

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[1] *Scientific Monthly*, 372, Oct., 1936.

TABLE II

Comparative Rating for First 29 Years

Country	Number of winners	Ideal quota	Per cent. attainment	Rank
Denmark	4	0.83	500	1
Sweden	6	1.4	423	2
Holland	7	1.8	400	3
Switzerland	3	1	300	4
Germany	27	15	180	5
Great Britain ...	14	8.4	167	6
France	13	9.3	140	7
Canada	2	2.3	87	8
Austria	3	3.7	81	9
Belgium	1	1.8	55	10
Italy	2	9.3	21	11
United States ...	5	27	18	12–13
Spain	1	5.4	18	12–13

the postwar populations of the countries in each table and dividing this sum by the total number of prize winners for that period. This gives the population corresponding to one prize winner. The post-war population of each country divided by the prize winning population gives the ideal quota for the respective countries.

The results calculated in this manner are tabulated in Tables I, II and III.

TABLE III

Comparative Rating for Last 10 Years

Country	Number of winners	Ideal quota	Per cent. attainment	Rank
Switzerland	2	0.43	465	1
Holland	2	0.92	217	2
Great Britain ..	7	4.0	175	3
Austria	3	1.8	162	4
Germany	10	7.4	135	5
United States ..	10	13	78	6
France	2	4.5	44	7
Italy	1	4.6	22	8

The true leaders in the sciences now appear since the smaller countries are no longer handicapped by their small populations. Four of the smaller countries lead in Tables I and II. Great Britain and Germany have had very uniform records. In the last ten years the United States has shown a distinct improvement. Her performance is four times as high as it was in the first twenty-nine years.

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THE WITCH OF ANDOR

In a letter to Science (Lancaster, Pa. and/or Garrison, N. Y.) of September 13, 1940, it is stated that "The use of the form 'and/or' in legal practice is well established." So is the expression "to-wit," if we mean widely rather than wisely established; but, if both these expressions can be restricted to legal usage, the English language will be better off. With a little better grasp of language, the original perpetrator would have avoided the fractional form (which as read aloud may be either "and over or" or "andorths"). Accepted English practice is to place an alternative term in parenthesis, as "and (or)." The chief abuse, however, is not in using the expression awkwardly and inaccurately but in using it at all. We have far too much of such writing as "You may have sugar and/or cream in your tea and/or coffee, and/or pepper and/or salt on your meat and/or potatoes." When really necessary, the idea is best conveyed by saying "or either" or "or both."

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SCIENTIFIC BOOKS

THE GEOLOGY OF CHINA

The Geology of China. By J. S. Lee. xv + 528 pp., 93 figs. London: Thomas Murby and Company. New York: Nordemann Publishing Company. 1940. $9.00.

This book grew out of lectures by the author in British universities during 1934–35 under the auspices of the Universities China Committee in London. It contains much valuable material, especially for those who want a rapid oversight of China's geology before studying intensively from sources of detailed information. For the geologist, the book is too brief, too inconclusive, too speculative. For the layman, it is far too full of technicalities, many of which are not needed to convey the meaning clearly. The book could be used in China as a text for students who have had their general physical and historical geology.

By far the most serviceable portion is the tenth chapter; a summary of the stratigraphy of China by regions, defining the formations and listing their chief fossils. All who are interested in the geology of Asia will welcome this chapter, which extends through 100 pages.

A lack which every geologist will immediately feel upon reading the book is the absence of a brief chapter on the history of geology in China. Strangely enough, the author gives a history of China as a nation, plausibly defending his course by claiming to show "the influence upon human geography of the natural regions which have been defined." But his history is political and cultural, and his interpretation of history—to say the least—is his own.

Lacking an account of the development of geology in China, the book gives no picture of the work of such men as Pumpelly, Richthofen, Obruchev, Loczy, Willis, Blackwelder, Fuller, Clapp, Andersson, Ting, Grabau, Wong, Berkey, Black, Teilhard—to give only a partial list. These men are casually referred to for local details; the reader must learn from other sources what large and constructive parts they played in the development of geological science in China, in the organization of publications devoted to the science and in arousing interest in the study.

Indeed, the author seems to suppress, as far as possible, credit to foreign workers—a common tendency in contemporary Chinese writing. It springs, no doubt, from the new nationalistic spirit, and we who see its counterpart in certain European nations should not be severe about it. The habit of scrupulously giving credit for work done is accepted in America as a matter of course; and we believe that China would gain, not lose, by giving full credit to the able and devoted men who have kindled the light of science for her.

The mineral resources of China are scarcely touched upon. Copper is mentioned thrice, each time in less than a sentence. Iron, gold, tungsten, antimony, are all dismissed in eight lines on one page. Petroleum fares better, being mentioned on four pages, on one of which it enjoys a paragraph. Coal is mentioned on many pages, chiefly as a member of a stratigraphic series, rather than as a resource. Kaolin, fire-clay, alunite, are barely mentioned. Especially in a pioneer book on the geology of China, a good analytical chapter on economic mineral resources would be welcome.

The book contains 93 illustrations, of which 26 represent fossils. Of these, 14 are full-page plates crowded with pictures of index fossils. No one could use these plates to identify fossils; they serve neither the geologist, the student nor the layman, except that the last would like to see a picture of the Peking Man. I think it would have been better to refer the reader to Grabau's volumes on index fossils of China—surely the briefest *serviceable* treatment of this vast subject—and to devote these plates to maps, structural cross-sections and topographic drawings such as Fenneman and Atwood have used so successfully in describing the United States.

Seven more figures are devoted to artifacts, none of which is needed in a book on geology, especially as four of them represent early Chinese pottery. Twenty-two figures are photographic views, but of these 17 are devoted to the problem of glaciation, leaving only five pictures for all the rest of China. The book contains 22 maps, of which the first represents the geomorphologic provinces, superposed upon the political provinces. Names of both sets of provinces, plus the names of mountain-ranges, rivers and lakes, are of course necessary; but to these are added many cities and all the railroads—the latter drawn in bolder lines than are any of the features for which the map was made. Twenty-one illustrations are devoted to structure—some to generalized structures such as folds made by pushing wet paper on a smooth surface according to Tsuboi's method (to whom no reference is made); some to reconstructions of geosynclinal troughs; while others are cross-sections recorded in the field.

The book is of value, even as it stands; and the author deserves praise for a gallant assault upon a most difficult task. The reviewer has known the author for more than twenty years and bears a warm personal friendship for him; and considers that he shows his friendship best in frankly pointing to some of the many defects in the book. The reviewer sincerely believes that the book should be thoroughly revised and reillustrated; that much of the speculative discussion in Chapters VII and VIII should be omitted and separately published as papers representing the author's views.

There are ten chapters, each with a selected bibliography. The first chapter describes the national provinces of China. Most of the 19 provinces as defined by the author are true geomorphologic units, based upon structure. To the reviewer this "physiographical" chapter seems the right place to tell of peneplanes, terraces, cycles of erosion, drainage-history; but these are postponed to inadequate, and partly erroneous, treatment in Chapter IV, pages 194–207.

Among the misconceptions in the present chapter only one will be cited:

The Manchurian Plain is "an homologous feature of the North China Plain" (page 12). But the former is a warped inland basin, or group of basins, whose floor is beveled across rocks of many ages and structures. The Manchurian basin is more nearly homologous with its western neighbor, the Gobi basin, than with the North China Plain, which is a confluent delta-plain made of Pleistocene and recent silts. Manchuria's true homologue for the North China Plain is the Liao delta, not the warped basins. Again, on page 14, we read, "After being submerged in the Gulf of Pechihli the Plain of Manchuria is continued further south-west by . . . the Plain of North China." This would be true if the Manchurian Plain were warped down under the Gulf and arched up again in the southwest.

Chapter II describes the ancient rock-floor of China, divided into three systems; the Archaean, the Wutai, separated by the Lulianian Revolution from the overlying Sinian system. The discussion of the last-named system is one of the best features of the book; but much confusion clouds the description of the earlier systems.

In Chapters III and IV the author is on firmer ground as he writes of "marine transgressions and epochs of tectonic movement"—extending from Cambrian through Triassic history; and "Post-Palaeozoic formations and the Yenshan movements," wherein he writes of continental deposits whose ages range from Triassic to Recent.

Chapter V is devoted to "Cathaysian geosynclines and geanticlines"—the troughs trending northeast-southwest in eastern China. The author discusses a Palaeocathaysian geosyncline, which received the Sinian deposits of late pre-Cambrian time, and was renewed after disturbances until the close of the Permian. The author recognizes "the obscure history of the Mesocathaysian geosyncline," in which he includes late Permian and Triassic marine sediments in South China, "the northern counterpart" of which came "down from the Arctic, past the maritime province of Siberia, and probably joined the Triassic trough in northern Korea." The Neocathaysian geosyncline is taken to include the marginal mediterranean Sea of Japan, the Yellow Sea and the Tunghai. This last is not named on any map in the book; and is not so called in most atlases. It should mean the East China Sea; but the confusion is increased by the author's statement (page 259) that the eastern Tsinling Range "sinks under the Yellow Sea or Tunghai"—whereas elsewhere he distinguishes between these two confluent seas.

He describes an "inner Neocathaysian geosyncline . . . an extensive trough running obliquely across China from northern Manchuria to the central Yangtze province. . . . In the North China Plain the sediments in the geosyncline probably amount to many thousands of feet in thickness." He adds to this bold statement, "Apart from the superficial cover, nothing is known about them at present." The only evidence cited for their great thickness is that borings at Tientsin showed fresh-water deposits 500 feet below sea-level. This fact is offered as evidence of subsidence; but the author disregards the lower sea-levels of the Pleistocene and the fact that delta sediments sink by compaction as the delta grows. The depth of these fresh-water deposits is too moderate to prove geosynclinal sinking.

Chapter VI treats of "east-west tectonic zones" of folded structure. One of these is in the Tannu and Kentai mountains. "The middle part of this zone is obviously disturbed by the Khangai Mountains which more or less follow the 'Irkutsk Amphitheatre' in trend, and which are undoubtedly related to the latter. Because of this powerful disturbance thrusting in from the north, the east-west zone could not have maintained its rectilinear front" (pages 247–248). Apparently the author thinks the Tannu and Kentai ranges were continuous, and that the Khangai is overthrust upon them from the north. No trace of such a structure is known in the field, nor are the rocks of the Tannu and Kentai identical. The inference appears to rest on the author's interpretation of "trends."

Farther south, "the Inshan zone" is made to include the many small short ranges just north of the great bend of the Yellow River. The author extrapolates these folds far to the eastward to account for the node in Hokkaido, where the Tertiary ranges of the Kurile arc and the Sakhalin folds "join and give rise to a great display of vulcanicity" (page 250). This entire thesis is speculative, to say the least. The only physical evidences which the author cites are certain east-west folds in Manchurian coal-basins and a coincidence in the approximate latitude of the node in Hokkaido with that of the Inshan zone. Similar reasoning is done throughout the chapter.

Reference has been made to the still more speculative chapters VII and VIII, respectively on "Shear Forms" and "Tectonic Types and Their Related Earth Movement."

Chapter IX is a review of the evidence bearing on "Pleistocene Climate in China." The author reviews the scattered observations and concludes that in the Lower Yangtze Valley, three successive glaciations took place, separated by interglacial epochs.

Chapter X, on "Regional Stratigraphy," is referred to in the first part of this review as the best and most serviceable chapter in the book. It is a pleasure to close a review that necessarily includes some criticism with a word of well-earned praise.

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SPECIAL ARTICLES

SEROLOGICAL SPECIFICITY OF HEAVY PARTICLES DERIVED FROM NORMAL ORGANS

The nature of certain particles separable from normal tissue extracts by relatively high centrifugal forces is under investigation in a number of laboratories.[1] In the course of studies of the virus of human influenza in this laboratory, it was found that particles of similar chemical composition could be separated from the lungs of normal, healthy mice and from the lungs of mice in the final stages of influenzal pneumonia. It has been suggested that such "high-speed sedimentable" cell components may correspond with histologically recognizable mitochondria,[2] and further, that they may be related with the pathogenic agent in certain virus diseases.

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[1] A. Claude, Science, 91: 77, 1940; K. G. Stern and F. Duran-Reynals, Science, 89: 609, 1939; C. R. Amies and J. G. Carr, *Jour. Path. and Bact.*, 49: 497, 1939; J. Furth and E. A. Kabat, Science, 91: 483, 1940; D. G. Sharp, A. R. Taylor, H. Finkelstein and J. W. Beard, *Proc. Soc. Exp. Biol. and Med.*, 42: 459, 1939.

[2] A. Claude, *op. cit.*

The question of the possible relation between these normal particles and the various infectious processes necessarily has led to an investigation of their serological specificity.

Healthy Swiss mice were dissected after death by ether, and the several organs were collected in jars submerged in an alcohol-dry ice bath. After storage at −7° to −10° C., the organs were ground with sand to form 10 to 20 per cent. suspensions in saline. After low-speed centrifugation the suspension was passed through a medium Mandler filter. This was followed by repeated alternate centrifugation at 25,000 RPM for 20 minutes and at 1,500 RPM for 5 minutes. The materials used for inoculation were washed three times, those for agglutination, only twice. Suspensions of particles from the following organs were prepared: liver, lung, kidney, spleen, pancreas, testicle, muscle and brain.

The material sedimentable from Mandler filtrates in each case formed a translucent, yellowish to reddish-brown pellet of gelatinous consistency, which could be resuspended only by very vigorous manipulation with a rubber-tipped plunger. Dark-field examination showed the particles to be of fairly uniform size about 0.1 μ to 0.3 μ in diameter, as might have been expected from consideration of the filter pore size and the centrifuge constants. The small bodies did not stain typically with the usual nuclear or acidophilic dyes, but were blackened by osmic acid and absorbed Janus Green B strongly, a fact which may support Claude's suggestion of a mitochondrial origin. Analyses of the sediments are not yet complete, but they appear to conform with the data of Claude,[3] *i.e.*, they contain nucleoprotein, a large proportion of ether extractable material and a high total ash.

When injected into mice intravenously, the suspended particles produced rapid death characterized by coagulation of the blood in the venous system and emptying of the left heart and arteries. In one instance (brain) the toxicity could be eliminated by suspension of the particles in antisera against any one of the organ particles, but usually not in normal serum. Preparations, other than from brain, have not yet been studied in this respect.

Antisera against each of the washed organ sediments were prepared by 7 intravenous injections into rabbits of 2 cc volumes at two- or three-day intervals. Nine days after the last injection, the animals were bled and the serum recovered. Normal serum from the same rabbits was kept in the frozen state for reference.

The following properties of the antisera have been found:

(1) Precipitins for mouse serum were usually entirely absent. In a few instances a slight precipitate was detected after preliminary incubation at 37° C. and overnight refrigeration and centrifugation, and only one of the antisera showed a slight ring formation with mouse serum diluted 1:100 on standing for 20 minutes.

(2) In half of the sera, there was an increase in mouse red cell agglutinins over that observed in the serum from the same animals before injection. In only three instances did the increase appear to be significant (10 to 20 times).

(3) Sheep cell hemolysins were present in all the antisera, with titers up to 1:5,000 with a 5 per cent. cell suspension. This observation is a confirmation and extension of that of Furth and Kabat[4] with respect to the presence of Forssman antigen in preparations from normal spleen of the chicken.

(4) A positive Kahn test was obtained with most of the antisera, but also with the normal sera.

Of the eight different types of antiserum, four (anti-brain, liver, kidney and testicle) showed reactions definitely specific for the homologous antigen. In slide agglutinations, the antigens were specifically agglutinated, *i.e.*, the reactions first became apparent (sometimes within one minute) in the homologous antiserum, although cross-reactions appeared later with some of the other antisera. The homologous reaction was usually stronger than the ultimate cross-reactions. Brain particle suspensions were agglutinated *only* by the homologous antiserum. Muscle, spleen, lung and pancreas particles have given indefinite or negative results thus far, although it is possible that the antisera in these cases were inadequate. Further investigation of this possibility is in progress. Table I summarizes the relationships encountered in our experiments.

TABLE I

HOMOLOGOUS AND HETEROLOGOUS AGGLUTINATION (SLIDE) OBTAINED WITH PARTICLES FROM VARIOUS MOUSE ORGANS

Particulate antigen	Rabbit serum *vs.* mouse organ particles from:									
	Brain	Kidney	Liver	Lung	Muscle	Pancreas	Spleen	Testicle	Saline	Normal sera
Brain	2	0	0	0	0	0	0	0	0	0
Kidney	0	4	3	1	2	0	0	0	0	0
Liver	0	1	3	1	1	0	0	0	0	0
Lung	0	1	1	1	1	0	0	0	0	0
Muscle	0	1	3	0	3	0	0	0	0	0
Pancreas ...	1	1	1	1	1	1	1	1	1	x
Spleen	0	2	2	2	1	2	2	2	0	0
Testicle	0	1	1	1	1	0	0	2	0	0

4 = all particles in a few large masses.
0 = no reaction.
1 to 3 = various degrees of agglutination.

Since cross-reactions appeared in a number of the cases, confirmation of the apparent specificity was sought through absorption experiments. Definite proof of specific antibodies in sera against kidney, liver, testicle and possibly muscle particles was obtained, as shown in Table II.

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[3] *Ibid.*

[4] J. Furth and E. A. Kabat, *op. cit.*

TABLE II

EFFECT OF ABSORPTION ON SPECIFICITY OF SLIDE AGGLUTINATION

Antigen	Serum absorbed with	Rabbit serum *vs.* mouse organ particles from :					
		Lung	Kidney	Muscle	Liver	Testicle	Saline
Kidney particles	......	1	4	1	2	0	0
	Kidney	0	0	0	0		
	Muscle	0	4	0	0		
	Liver	0	4	0	0		
	Sheep red cells	1	4	1	2		
Liver particles	......	1	1	2	4	0	0
	Kidney	0	0	0	3		
	Muscle	0	0	0	4		
	Liver	0	0	0	0		
	Sheep cells	1	1	2	4		
Muscle particles	......	1	1	3	3	0	0
	Kidney	0	0	±	0		
	Muscle	0	0	0	0		
	Liver	0	0	2*	0		
	Sheep cells	..	..	..	..		
Testicle particles	......	1	1	1	2	2	0
	Liver	0	0	0	0	2	

* Apparently some specificity in this experiment, but not observed in other muscle preparations.

It is obvious from these experiments that the antibodies can be absorbed completely only by the homologous antigen, while cross-reactions apparently disappear upon absorption with any one of the heterologous antigens. The Forssman antibodies are not concerned with these cross-reactions, since no change occurs upon complete absorption with sheep cells. There was no definite relation between the mouse serum precipitins or mouse red cell agglutinins and these cross-reactions.

Using particles derived from another species—the ferret—we have observed agglutination of liver only, by mouse liver antiserum, and of brain only by mouse brain antiserum, while kidney particles were not agglutinated by any one of the sera. Ferret muscle antigen cross-reacted with several antisera, other than anti-muscle.

These experiments prove that particles derived from some normal mouse organs by high-speed centrifugation (25,000 RPM) show, in addition to the Forssman antigen, organ specific differentiation. The question of organ specific structures in tissues and cells has been studied repeatedly (*cf.* Landsteiner[5]). While in certain instances (*e.g.*, lens, brain and others) organ specificity is demonstrable without great difficulty, in other cases (kidney, liver) the results have been more or less indefinite.

As a result of these various studies, different types of organ-specific antigens have been identified.[6] One group is characterized by the fact that the same antigen is present in the homologous organ of many different species. Our results show that liver as well as brain particles conform with this type.

The kidney particle preparations employed in our experiments belong to another group of organ specific antigens which are found in one organ from one species only. However, since we have used only two species, it is obvious that these observations must be extended.

In a number of instances, it has been possible to ascribe organ specific reactions to alcohol extractable material.[7] The particles used in this study contained high percentages of lipoids, but the relation of these fractions to the specificity is still under investigation.

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STABILIZATION OF IODINE IN SALT AND FEEDSTUFFS

ON the Industrial Fellowship on iodine at Mellon Institute we have had occasion to investigate broadly the factors responsible for the loss of iodine from iodized salt and iodized mineral feeds. These mixtures may contain any or all of the following substances: ferric oxide, copper sulfate, cobaltous nitrate, sodium chloride, manganese sulfate, calcium carbonate, calcium phosphate, sodium sulfate, sulfur, potassium iodide, volatile flavors, organic meals and vitamin concentrates. Potassium iodide is furnished to the feed manufacturer in the form of either an iodized mineral mixture, a concentrated iodized pre-mix containing the essential minerals or an iodized salt. The primary cause of loss of iodine is through oxidation of the iodide to free iodine with subsequent volatilization. Another important factor is the absorption of potassium iodide by the fabric or cardboard containers. The formation of free iodine not only results in a loss of iodine but also causes a decrease in the vitamin C content of the feed.

Iodized mineral feed mixtures lose between 9 per cent. and 20 per cent. of their iodine content during four months' storage under ordinary conditions. Oxidation occurs mainly through the catalytic action of iron, copper and manganese compounds present in the mixtures. These reactions take place only in the presence of moisture and are accelerated by the action of light. An important synergism is observable in this catalytic action. Ferric oxide becomes appreciably soluble in the presence of soluble manganous compounds, and the catalytic activity of iron and copper together is much greater than the additive effects of iron and copper separately.

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[5] K. Landsteiner, "The Specificity of Serological Reactions," C C Thomas, Springfield, Ill., 1936.

[6] E. Witebsky, Report of Proceedings, 2nd Intern. Congress of Microbiol., London, 1937.

[7] E. Witebsky, *Zeitschr. f. Immunitätsf.*, 62: 3, 1929.

[8] Nemours Foundation Fellow.

The loss of iodine from iodized salt depends upon the oxidizing impurities in the salt, chiefly chlorate, nitrate and ferric chloride. Iodized salt for animal feeding, which contains large amounts of potassium iodide, loses iodine with great rapidity. Iodized salt for human consumption, which contains 0.02 per cent. potassium iodide, loses 40 per cent. or more of the iodine in eighteen months. If the salt is freshly prepared, approximately 15 to 20 per cent. of the iodine is lost during the first month.

Stabilization by the use of alkaline agents and reducing agents has been recommended and extensively used. But this treatment has not been entirely successful because of the inability to obtain adequate contact between the reacting components in a dry powder. The employment of a reducing agent in conjunction with a soluble pyrophosphate is more effective. Pyrophosphate forms an inactive complex with oxidized iron; it also destroys the synergism between iron and copper.

A new and simplified procedure for stabilizing the iodine reinforcement of comestibles has come from our work. The process consists of milling 100-mesh alkali iodide with a small portion of a non-toxic metallic soap. The milling of 92 parts of potassium iodide with 8 or more parts of calcium stearate in the form of an impalpable powder is recommended; the powder density of the calcium stearate should be as low as possible. The resulting product is a stable free-flowing powder, coated with calcium stearate and practically insoluble in water. The coating is rapidly emulsified in the presence of bile. Calcium stearate is non-toxic and may be ingested in reasonable amounts with complete physiological safety. Various grades of the impalpable powder are available commercially.

A mineralized salt, containing 10 per cent. ferric oxide, 2 per cent. copper sulfate, and 4 per cent. potassium iodide coated with calcium stearate, has lost only 0.9 per cent. of its iodine content during storage for four months, while the same formula without calcium stearate has lost 15 per cent. of the iodine. An iodized livestock mineral containing 0.21 per cent. stearate-coated potassium iodide lost 0.5 per cent. of the original iodine content during two months, while an unstabilized mineral containing the same ingredients lost 14 per cent. of its iodine content. Absorption of the stearate-coated potassium iodide by cardboard, paper or fabric containers does not occur.

Calcium stearate also functions to prevent caking in table salt. As iodized table salt contains 0.02 per cent. potassium iodide, it is necessary to employ 0.2 per cent., or ten times as much calcium stearate as potassium iodide, to be effective in preventing caking. The cost is comparable to that of present methods.

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A NEW FACTOR OF THE VITAMIN B COMPLEX REQUIRED BY THE ALBINO MOUSE

IN view of the wide use of the albino mouse as an experimental animal, particularly in medical research, it is surprising that so little is known about its dietary requirements. The work that has been done[1,2,3,4,5] indicates that the nutrition of the mouse differs markedly from that of the rat. It was stated by Birch, György and Harris[6] that mice on the Goldberger blacktongue diet supplemented with 5 International Units of thiamin and 15γ of riboflavin injected twice a week failed to grow and developed skin lesions and loss of hair, whereas rats on the same diet grew normally.

In the study of the requirements of the albino mouse for the several factors of the vitamin B complex, a basal diet consisting of purified casein, 18 per cent., sucrose, 75 per cent., cod liver oil, 1 per cent., butter fat, 2 per cent., and Osborne and Mendel's salt mixture, 4 per cent., is being used, supplemented with known factors of the B complex.

When crystalline pyridoxin, thiamin, nicotinic acid and riboflavin are injected at various levels up to 10γ, 25γ, 25γ and 15γ respectively per day, failure of growth results in every case, and a characteristic skin lesion develops in from 30 to 40 days. If the crystalline supplements are fed with the basal diet at levels of 100γ of pyridoxin, 250γ of thiamin and nicotinic acid and 150γ of riboflavin daily, the same results are observed as when the B factors are injected.

The addition of liver or yeast, or the water or dilute (30 per cent.) alcohol extract of liver or yeast to the diet produces normal growth and maintains healthy skins in mice. However, feeding the basal diet supplemented with pyridoxin, thiamin, nicotinic acid and riboflavin with the addition of the filtrate from a fuller's earth adsorption of either yeast or liver extract neither produces growth nor prevents the appearance of skin lesions in mice when feeding amounts of filtrate equivalent to 0.1 gram and 0.2 gram of yeast daily or 0.5 gram of liver every other day. In only one case[7] have skin lesions been described on a diet adequate in thiamin, pyridoxin, nicotinic acid, ribo-

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[1] H. H. Beard, *Am. Jour. Physiol.*, 76: 206, 1926.

[2] H. H. Beard, *Am. Jour. Physiol.*, 75: 668, 1925.

[3] F. C. Bing and L. B. Mendel, *Jour. Nutrition*, 2: 49, 1929.

[4] E. Pomerene and H. H. Beard, *Am. Jour. Physiol.*, 92: 282, 1930.

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[6] T. W. Birch, P. György and L. J. Harris, *Biochem. Jour.*, 29: 2830, 1935.

[7] P. György and R. Eckhardt, *Nature*, 144: 512, 1939.

flavin and the "filtrate" or "rat growth" factor fed to rats. The symptoms described are similar to those reported here, but differ in certain essentials.

The skin lesions observed in the mouse differ in several respects from conditions of dermatitis described in the literature.[8] The paws, ears, nose and tail, and in most cases the eyes appear normal. In a few cases a sticky exudate is observed about the eyes. The lesions are preceded by loss of hair on the abdomen, closely followed by the appearance of shiny dry skin in the inguinal region. This in turn is soon followed by a scaly dandruff-like appearance beginning almost simultaneously on the back of the neck and in the inguinal region. If the animal survives this stage of the deficiency, the pelt frequently begins to come off in large plaques, particularly on the back, leaving a dry but otherwise normal-appearing hairless skin. In some cases it has been possible to keep the animals alive until they became completely denuded except for a slight amount of fuzzy hair around the head. In some cases, the peeling off of the pelt does not occur, but instead the dandruff-like appearance spreads over the body and the hair gradually falls out, leaving the animals covered with dry white scales. Early in the course of the deficiency the animals usually assume a hunched position with the hind feet drawn far up underneath the body. Histopathological examination of all organs and sections of the skin is now being made. At autopsy, the animals are found to be emaciated, but otherwise normal in gross appearance.

Mice require a water-soluble factor other than thiamin, nicotinic acid, pyridoxin, riboflavin and the "filtrate factor."[9] The required factor is present in yeast and liver. A study of the properties of this substance is now in progress.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SUBSTITUTE FOR EDESTIN

Edestin, the globulin of hemp-seed, has been regarded as a standard example of the seed globulins for many years. Osborne[1] subjected this protein to more detailed and extensive study than any other globulin, and his demonstration with Mendel[2] of its adequacy as the sole source of protein in the diet of animals has led to extensive use of edestin in certain types of animal experimentation. It serves, for example, as a convenient protein relatively free from phosphorus.

In recent years, many amino-acid determinations[3] have been made upon edestin, with the result that the composition of this protein is better known than is that of any globulin in its molecular weight class; in the cases of only a few other proteins are higher summations of amino-acids available. Furthermore, much attention has been given to its physical properties,[4] and the preparation of a sample of this protein has long been a standard exercise in laboratory courses in biochemistry.

The passage of the Marihuana Law of 1937 has placed restrictions upon trade in hemp-seed that, in effect, amount to prohibition. The seed may be purchased only under license, and transfer is subject to a tax of one dollar an ounce (if illegal, one hundred dollars an ounce). On application to the Collector of Internal Revenue, properly accredited persons may obtain exemption from this tax, and provisions are made in the law so that scientific research on marihuana (the legal definition of which includes all parts of the plant, and all products, save fiber, oil and seed cake prepared from it and from its seed) shall not be impeded.

Hemp-seed is produced only in small quantities in the United States, chiefly in Kentucky, and the plant may be grown only under license. Most of the hemp-seed is imported from the Orient, and there are only a few importers in the country who are licensed by the Federal Narcotics Division to engage in this trade. The seed is devitalized by heat treatment on receipt by the importers and may then be sold without restriction. It is used chiefly in various special feeds such as bird-seed.

The general effect of these restrictions is to render the purchase of hemp-seed for the preparation of edestin a time-consuming and troublesome process. The devitalized seed is useless, since the yield of protein is reduced to less than one twentieth of that from untreated seed. Although some laboratories may be willing to face the difficulties involved, the licensed importers are not enthusiastic about cooperation, since they think in terms of tons and they are also fully alive to the penalties that are risked if unauthorized persons secure some of the seed.

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[8] N. Halliday and H. M. Evans, *Jour. Nutrition*, 13: 657, 1937.

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[4] E. J. Cohn, *Physiol. Rev.*, 5: 349, 1925; N. F. Burk and D. M. Greenberg, *Jour. Biol. Chem.*, 87: 197, 1930; C. F. Failey, *Jour. Am. Chem. Soc.*, 54: 2367, 1932; R. W. G. Wyckoff and R. B. Corey, Science, 81: 365, 1935; E. J. Cohn, *Chem. Rev.*, 24: 203, 1939.

[9] S. Lepkovsky, T. H. Jukes and M. E. Krause, *Jour. Biol. Chem.*, 115: 557, 1936.

It seems clear that the long and important career of the protein edestin is coming to a close in the United States. A substitute must be found, and it is the purpose of this communication to draw attention to the problem this presents. The substitute for edestin must be a seed globulin of approximately the same solubility; it should be a protein that is easily prepared in crystalline and therefore presumably pure form; it should be derived from a seed that is an important crop not only in America but elsewhere, and it is desirable that it should be relatively cheap. A survey of possibilities in this field has led, largely by elimination on one ground or another, to the plants of the family Cucurbitaceae. Many species are commonly grown, and considerable study has been given to the proteins. Squash-seed globulin was prepared by Osborne[5] in 1892 and has been occasionally investigated since. Cantaloupe seed has been studied by Jones and Gersdorff.[6] Hirohata[7] has examined the globulins of some thirty-eight varieties and species of eight genera of this family and has drawn attention to the close similarity, if not identity, of the globulins from closely allied species. Kiesel and his collaborators[8] and also Krishnan and Krishnaswamy[9] have studied the globulin of watermelon seed.

Considerations of availability have led us to the tentative suggestion that the globulin of the pumpkin seed (*Cucurbita pepo*)[10] may be found to fulfil most of the requirements of a substitute for hemp-seed edestin. Numerous varieties are grown, and the seed is a waste product of the canning industry in some states. It is always available on the market at a price that is usually a small fraction of that commanded by most cucurbit seeds.

A series of proteins from commonly available cucurbit seeds is under investigation in this laboratory. Although there are minor differences in the behavior of the different seeds, all yield well-crystallized globulins when the ground, whole seed is extracted by means of a hydraulic press with warm 10 per cent. sodium chloride solution. After removal of the emulsion of fat which readily rises from the warm solution, the filtered aqueous phase is diluted to about 2 per cent. sodium chloride concentration at 60° C. This clear solution is slowly cooled to about 5° C., when the protein deposits almost entirely in the form of octahedral crystals. Reprecipitation under similar circumstances gives, as a rule, a very fine product. The yield is of the order of 10 per cent., somewhat higher than that usually secured from hemp-seed.

A report on the preparation and nutritive properties of one or more of these globulins and on certain of their chemical properties will form the subject of a later communication.

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[5] T. B. Osborne, *Am. Chem. Jour.*, 14: 662, 1892.

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[9] P. S. Krishnan and T. K. Krishnaswamy, *Biochem. Jour.*, 33: 1284, 1939.

[10] *Cucurbita pepo* includes the common field, pie and cattle pumpkin of North America and also the vegetable marrow. There are several varieties recognized in systematic works, and many varieties are commonly grown. *C. moschata* is a closely allied species that includes the cushaw and crookneck squashes and other varieties known both as pumpkins and as squashes. *C. maxima*, also closely allied, includes such well-known squash varieties as Hubbard and Boston Marrow as well as certain very large varieties commonly called pumpkins. Whether varietal or even specific differences in these plants are reflected in the main storage globulins of the seeds is unknown. Uncertainty on this point presents no graver problem, however, in this case than is presented by any other protein of vegetable or for that matter of animal origin.

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A MODERN CONCEPTION OF THE ACTION OF THE NERVOUS SYSTEM[1]

By Professor G. H. PARKER

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It was my privilege as a young student of zoology to have made the acquaintance of Professor W. K. Brooks in the summer of 1889 at the Laboratory of the United States Fish Commission, Woods Hole. Here a body of mature investigators in marine biology was gathered and we younger workers were allowed to associate with them greatly to our advantage. It is an honor to be invited by Miss Fowler to deliver this lecture, and it would be a pleasure to me if I could think of it as a small return to Dr. Brooks for the kindly help and encouragement he gave to all of us who were associated with him at the Woods Hole Station. In a way this lecture is an appropriate tribute to Dr. Brooks, for much of its contents was brought to light in those laboratories that have grown up at Woods Hole around the original one where he worked. I am further disposed to think that the special subject herein discussed, the mode of interaction of nervous elements, would have claimed a fair share of Dr. Brooks's interest, for his philosophical temperament would have led him not only to seek a clear picture of the nervous mechanism in animals, but to gain an insight into the way in which this mechanism acts.

The histologists of half a century ago described the nervous system as composed of ganglion-cells, nerve-fibers and fibrillar material. With the advent of the Golgi method in the last quarter of the past century it became possible to determine the relations of these elements to each other. Golgi's idea that the fibrillar material forms a true network was abandoned for Ramòn-y-Cajal's conception of the fibrillar substance as a system of branches by which one nerve-cell is brought into contact with others but without real unions. This separateness of the nerve-cells was foreshadowed in the embryological studies of His and was abundantly confirmed subsequently by the histogenetic investigations of Harrison. Meanwhile Waldeyer in 1891 had seized upon this revised histological picture of the nervous system, and, recognizing that nerve-fibers were parts of nerve-cells, had been led to the conception of the true histological units or neurones whose functional continuity was through fibrillar contacts. These points of mutual contact, the synapses, were shown by Sherrington to have a kind of transmission unlike that of a nerve-fiber. They proved to be polarized in that they transmitted nerve impulses in one direction only as contrasted with the double conduction in nerve-fibers. Synaptic transmission moreover was more time-consuming than fiber transmission. Many neurophysiologists have interpreted synaptic transmission as a purely electrical phenomenon, but of recent years there has been a growing opinion that synaptic transmission is accomplished by substances, variously designated as neurohumors, neurohormones, or chemical activators, which, produced on one side of the synapse, pass across the minute interruption and stimulate the opposite side. The chief question to be discussed in this lecture is whether there is evidence for the existence of such substances and what their natures may possibly be.

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[1] Third William Keith Brooks Lecture, delivered at Greensboro College, Greensboro, N. C., April 25, 1940.

Such substances may be sought between receptor-cells and their associated nerve-fibers, or where one neurone is in contact with another in nervous organs, or finally where efferent neurones terminate on effectors such as muscles, glands, color cells and the like. It is to the last set of these contacts, those between chromatic nerve-fibers and their associated color cells or chromatophores that I propose to direct your attention.

By means of chromatophores lodged for the most part in the skins of many animals these creatures can change their color in many directions and often with astounding quickness. These changes were well known to the ancients and were recorded by Aristotle and by Pliny. They have excited the attention of naturalists down the ages. Such changes are to be seen among squids and devil-fishes, shrimps and prawns, and among the lower vertebrates including the fishes, the amphibians, and the lizards. Incidentally many other animals show such changes, but the best-known examples are found among the groups just indicated. For conciseness I shall limit my discussion to the chromatic activities of the lower vertebrates.

If a smooth dogfish, Mustelus, be placed in an illuminated marine aquarium with white sides and white bottom, it will assume in the course of a few days a pale, translucent flesh-tint. Placed now in a similar black-walled tank, it will become in a day or so deep gray. These color changes from dark to pale and the reverse constitute the whole color range of this fish and are accomplished by the concentration or dispersion of a dark pigment, melanin, in myriads of chromatophores in the skin of this fish. In the concentrated state the chromatophores or, better, melanophores are black dots each about 30 microns in diameter; in the dispersed state they are richly branched, dark bodies each covering an area roughly 200 microns in diameter. As dots they are inconspicuous in the total area of the skin and induce the pale tint in the fish, but as branched bodies they together cover large areas of skin and bring about the dark coloration. This relatively simple mechanism illustrates the device by which most lower vertebrates change their tints though in many of these animals their melanophores are supplemented by chromatophores of other colors, red, orange, yellow, white, and the like.

In 1858 the celebrated English physician Lister studied the color changes of the common frog and made the discovery that the integrity of the eyes in this animal was necessary for its chromatic activities. He concluded that these activities were in the nature of nervous reflexes and were mediated by the central nervous system of the animal. Pouchet, in a series of papers published between 1872 and 1876, showed that in fishes the parts of the nervous system especially concerned with color changes were the sympathetic or autonomic tracts. In the first quarter of this century Sumner and subsequently Mast demonstrated that certain fishes, the flatfishes or flounders, not only changed their general tint but also modified their color patterns to fit in a rough way that of their surroundings. This change of pattern may be regarded as perhaps the most complicated of the color changes in any animal and represents in this respect the pinnacle of efficiency in such chromatic systems.

Up to about 1920 all investigators in this field of research accepted the nervous interpretation of the control of animal color changes, but beginning with 1922 a novel view concerning such changes was advanced. In that year Hogben and Winton showed by a variety of tests that the nerves in frogs had little or nothing to do with the color changes in these animals, but that such changes were dependent upon an internal secretion from the pituitary gland. A frog from which this gland had been removed became pale and remained so. On injecting into such a pale animal an extract of the intermediate lobe of this gland it was observed that the creature became very dark but blanched again after time had been given for the extract to have disappeared. From this and other like tests Hogben concluded that amphibians became pale when the pituitary secretion, now called intermedin, was absent from their blood and that they were dark when this substance was present in their circulation. He was thus led to contrast the hormonal control of color changes in amphibians with the nervous control of these changes in the fishes and in the lizards. Hence so far as the color changes of amphibians were concerned an entirely novel element was introduced. To discuss the importance of hormonal or humoral agents in color changes I propose to consider the chromatic activities in three lower vertebrates, the frog, the smooth dogfish, and the catfish.

The chromatic system in the frog so far as activation is concerned may well represent the simplest type of this process. As I have already mentioned, Hogben and Winton expressed the view that the color changes *in the frog were fully explicable from the standpoint* of the presence or absence of a single chromatic secretion. This opinion was espoused by Parker and Scatterty. Meanwhile Hogben and Slome in their study of the South African toad Xenopus were led to conclude that amphibians possessed a second and in this instance a blanching neurohumor also from the pituitary gland, a conclusion supported by the work of Soderwall and Steggerda on frogs. Whether amphibians possess one, two or more chromatic hormones is an open question, but however this may be, it is agreed by all recent physiological workers that melanophore activation in the frog is humoral and not nervous. The innervation of frog melanophores as shown in histological preparations by some recent students of this subject (Perotti, Tusques) has in no instance been demonstrated to be concerned with color changes and may well have to do with other nervous functions. A purely humoral activation of chromatophores appears to hold not only for amphibians, but also for the lamprey eels (Young), most sharks and rays (Young, Parker, Wykes), the Carolina lizard (Kleinholz), and the shrimps, prawns, crabs and the like (Perkins, Koller, Abramowitz, Hanström, Carlson, Brown, Kleinholz and others).

A second type of chromatic activation is to be seen in the smooth dogfish Mustelus. Like the frog this fish becomes pale on the loss of its pituitary gland and darkens again temporarily to an injection of pituitary extract (Lundstrom and Bard). When its cutaneous nerves are cut the denervated areas become pale, and the electric stimulation of cutaneous nerves also induces local blanching. Hence in Mustelus active blanching is nervous though favored by the absence of intermedin. In this fish then darkening is due to intermedin and blanching is the result of the action of concentrating nerves (Parker and Porter). Blanching in Mustelus, suspected of being caused by vasomotor changes (Hogben, Wykes), has been shown to be independent of circulatory disturbances (Parker). Another chromatic vertebrate which appears to have a combined system partly humoral and partly nervous is the horned toad (Phrynosoma), a lizard of the North American deserts. As a matter of fact the chromatophoral system in this creature resembles in a striking way that in Mustelus, for the darkening of Phrynosoma is due to intermedin and its blanching is the result of the action of concentrating nerves (Redfield, Parker).

The third example of color change to which I wish to call your attention is that of the catfish Ameiurus. This fish has a melanophore system which enables it to range from a very pale greenish yellow to coal-black. Its dark phase is dependent chiefly upon intermedin from its pituitary gland. If in a pale fish one *of its radiating caudal nerves is cut, a dark band* corresponding to the area of distribution of the nerve will form. This type of response has long been known in other chromatic vertebrates and has been commonly attributed to paralysis. If, however, a pale fish in which such a caudal band has been formed is kept in a white-walled illuminated aquarium, the band will blanch in a few days. If now the nerve is cut a second time and at a point a little distal to the first cut, a second band will form and remain conspicuous for a day or two. The formation of this second band shows that the production of such bands can not be due to paralysis, for the nerve to form this renewed band must be still active. The nerve is without doubt reactivated by the second cut, and the particular fibers thus brought into action are dispersing fibers. This test and others like it have led to the conclusion that Ameiurus darkens not only through the action of intermedin but also by means of dispersing nerves. Ameiurus blanches in consequence of concentrating nerves whose action in this and many other fishes has long since been demonstrated by electric stimulation. Thus the melanophores of Ameiurus have a double innervation, one set of nerve-fibers controlling the dispersion of pigment and the other the concentration of this material. Such a double innervation is consistent with the histological discoveries of Eberth, Ballowitz, and Eberth and Bunge all of whom have shown that two or more nerve-fibers may reach the same melanophore. The double innervation of teleost melanophores has also been demonstrated in studies of partly innervated areas and in the regeneration of melanophore nerves (Mills, Parker and Porter, Abramowitz). The catfish then represents what may be regarded as an extreme instance in chromatic complication in that its color system involves concentrating and dispersing nerve-fibers and intermedin. This complex system has been shown to occur in a number of other teleosts, and it is probably present in the African chameleon. Thus from the frog with its possible single chromatic humor, intermedin, one may pass to mixed chromatic systems with one set of nerve-fibers and intermedin, as in Mustelus, or to those with two sets of fibers and intermedin, as in Ameiurus. No chromatic vertebrate is known that does not possess intermedin as a darkening agent, though in some, as for instance Fundulus, this agent may be very subordinate. Mixed systems, partly humoral and partly nervous, occur among fishes and lizards. Apparently there is no instance in the vertebrates of a purely nervous chromatic system.

What are the details of melanophore activation? Of the agents to this end intermedin is the most obvious and universal in the vertebrates. Under appropriate environmental conditions this substance is discharged from the pituitary gland of a given chromatic animal into its blood by which the intermedin is carried over the animal's body to its melanophores. These cells are thereby excited to disperse their pigment. Thus intermedin appears to act directly and immediately on the color cells themselves. The way in which the chromatic nerves, dispersing and concentrating, influence melanophores can be surmised best by studying the blanching of dark bands in the tails of such forms as the killifish and the catfish.

A dark band produced in the tail of a pale killifish or a pale catfish by cutting a bundle of chromatic nerve-fibers will blanch in such a fish on a white background in one or more days. Such a band does not blanch uniformly but begins to fade first on its edges leaving its axis dark. Finally the dark axis fades completely. In the killifish bands one millimeter wide blanch on the average in about 30 hours, those two millimeters wide, in some 78 hours (Parker). In a catfish a band one ray in width becomes pale in 2 days, one two rays wide in 5 days and one three rays wide in 10 days (Abramowitz). These peculiarities show that the fading band is not influenced uniformly as, for instance, from below by the blood and lymph, but that it is changed by something that affects it laterally. Either a substance escapes from the sides of the band and by its absence allows the lateral melanophores to concentrate their pigment or an external agent makes its way from the surrounding tissue into the edges of the band and thus induces pigment concentration. Matsushita has performed an experiment which shows that the second of these alternatives is the correct one. If a new caudal band is cut in a pale fish and in such a position that on one of its sides there is a fully blanched denervated band and on the other the normal innervated pale area of the tail, its method of fading will be significant. Matsushita showed that it fades only on that side which is next the innervated pale area and not on the opposite denervated side. Its blanching is therefore not due to the loss of a darkening substance, for this could escape equally from either side. It must result from the invasion of a blanching agent whose source is the innervated pale portion of the tail. In a somewhat similar way it has been shown that a denervated pale band will darken over only that portion of its extent which is flanked by two newly formed dark bands of half the length of the pale band and not over that part not so flanked (Parker). Thus there is good reason to conclude that pale innervated regions contain an active concentrating substance and that dark nervously active regions contain an equally effective dispersing substance. Both these substances may pass by slow degrees from their regions of origin into adjacent regions. Since the regions of origin of the concentrating substance are the regions of active concentrating nerve-fibers and the regions of origin of the dispersing substance are the regions of activated dispersing fibers, it is natural to conclude that these substances are the products of their respective sets of nerve-fibers each in its particular way activating the melanophores concerned.

It has already been pointed out that these substances do not act as though they were dissolved in blood or in lymph. They are much too circumscribed in their effects and much too slow in their spread to be in aqueous solution. The only other constituents of the tissues in which they are likely to be dissolved are the lipoids, and it is probable that these activating substances are carried in such fatty materials and that they migrate by diffusing slowly through such materials. This view is supported by the fact that an Italian olive-oil extract of a dark catfish skin when injected as a coarse emulsion under the skin of a pale catfish will cause the formation of areas of dark color. These dark areas can not be produced by injections of pure olive oil or by oil extracts of tissues of other than dark skin. They are therefore believed to be due to some substance dissolved from the dark skin by the oil. Such oil-soluble materials have been called lipohumors in contrast to hydrohumors like, for instance, intermedin which, as already indicated, act in aqueous solution on melanophores (Parker).

Although the dispersing and the concentrating lipohumors of the catfish give evidence of being normally dissolved in the lipoid constituents of its skin, these humors appear to be also soluble in water. Dissolved in this medium they may be tested for their chemical characteristics. Aqueous extracts of the dark skins of catfishes when appropriately prepared and applied to the muscle of the leech give every evidence of containing acetylcholine. This substance moreover when injected into a catfish previously treated with eserine will darken the fish. It is therefore probable that the darkening lipohumor of the catfish is acetylcholine (Chin; Chang, Hsieh, and Lu; Parker). This substance has long been known to be a most remarkably efficient agent in many organic operations, and this peculiarity appears in the darkening of the catfish, for the skin of this creature is of a deep hue when it contains one part by weight of acetylcholine to about 13,000,000 parts of skin.

If it is probable that the dispersing nerve-fibers of the catfish act on melanophores through the neurohumor acetylcholine, what can be said of the concentrating fibers? Here aqueous solutions may also be used in tests. When such solutions properly prepared are applied to the frog's heart they are found to give evidence of containing adrenaline (Parker). As has long been known this substance when injected directly into a dark catfish will cause it to blanch. Hence there is reason to believe that just as the dispersing nerve-fibers probably act on melanophores through the production of acetylcholine, so the concentrating fibers affect melanophores by the discharge of adrenaline. This substance, though a highly efficient agent in the control of organic activities, is by no means so remarkable in this respect as acetylcholine. A catfish will blanch when its skin contains one part by weight of adrenaline in 350,000 parts of skin. Thus in the catfish the concentrating fibers appear to produce adrenaline and may be classed therefore as adrenergic; and the dispersing fibers acetylcholine and hence classed as cholinergic.

The nervous component of the melanophore system in the catfish is therefore organized upon the plan of opposing sets of nerve-fibers with their appropriate neurohumors as occurs in other parts of the autonomic system. But the melanophore system in this fish has in addition to these two neurohumors a third one, intermedin, which, so far as is known, has not been identified in other parts of the nervous organization of vertebrates. Nor is this the limit, for the chromatophore system in other fishes includes in addition to melanophores other types of color cells such as xanthophores, erythrophores, leucophores and the like, none of whose activities has been so fully analyzed as those of the melanophores, yet whose functional performances are such as to imply the presence of other and different neurohumors. Thus the conditions in chromatic vertebrates give promise of a considerable array of these substances still to be discovered.

But more important than a promised increase in the number of neurohumors is the peculiar behavior of the two nervous components in the catfish to their organic environment. Acetylcholine when introduced in aqueous solution into the body of a catfish is quickly destroyed by the cholinesterase of the animal's tissues. If, however, it is introduced dissolved in oil, it will remain effective for days. Apparently it is protected from such agents as cholinesterase by being in solution in the oil and it only slowly and gradually diffuses out from this medium into the adjacent aqueous environment. Here it may act momentarily on the melanophores before it suffers destruction. Thus oily deposits in general, including the cell lipoids, may serve as protective reservoirs for acetylcholine and in consequence greatly lengthen the period of this agent's activity. In this way the darkening action of acetylcholine may be greatly prolonged.

The same seems to be true of adrenaline. Although this substance is not rendered ineffective in the fish's body with any approximation to the rapidity with which acetylcholine is, it is nevertheless none too stable and in oily mixtures its activity far outlasts in point of time that which it shows in purely aqueous solution. This feature of neurohumoral activity is not without general biological significance, for it points to lipoids and other like substances as possibly important protective repositories for susceptible agents whose existence in aqueous solution in the organism might be very limited and precarious.

From this brief survey of the means of activation of a limited group of chromatophores it must be evident that neurohumors not only exist in animals, but that they exist in reasonable variety. They may be defined as hormones produced by nervous tissue or by glands appended to that tissue and concerned with the activation or inhibition of other nervous tissue or its effectors. That they occur in many parts of the nervous system is beyond doubt; that they serve in certain regions as means of synaptic transmission is highly probable; but that they are the exclusive means of such transmission can not at present be affirmed. This uncertainty leaves open still the possibility of electrical transmission in certain places. It is, however, conceivable that even here neurohumoral transmission may also occur and that in such instances these two supposedly different types of transmission may be merely two aspects of the same operation (Forbes). In conclusion it may be said that neurohumoral transmission offers a natural explanation for synaptic polarization, for if one side of the synapse is secretory and the other receptive, transmission would naturally be in one direction only. Moreover such a double operation might well be expected to involve synaptic delay not to be looked for as a necessary step in electric transmission. Because of these features the neurohumoral rather than the electric conception of transmission at the synapse has been gaining ground and the general conception that complex nervous activity involves a myriad of momentary neurohumoral discharges and receptions is coming to be a significant picture in the minds of modern neurophysiologists (Dale).

ENGINEERING AND RELIGION[1]

By DUGALD C. JACKSON, JR.

DEAN OF ENGINEERING, UNIVERSITY OF NOTRE DAME

HIGHER education is primarily concerned with intellectual training and the acquisition of knowledge concerning existent facts. However, the importance of the development of the individual and his personality has come before engineering educators in more recent years. Much thought and discussion has been given to the fact that humanistic subjects (the so-called cultural subjects) have a part in the development of the student.

The early steps were merely the insertion of presumably beneficial humanistic subjects into the engineering curricula as separate and individual courses. Gradually there has come the recognition that there is need for an interrelation among these discrete humanistic subjects and that they should be an integral and coordinated part of the engineering curricula. Although the necessity for humanistic subjects in the engineering curricula is accepted, there is difference of opinion as to what proportion of an engineering curriculum should consist of humanistic subjects, and as to whether certain subjects should be included or omitted. In other words, the amount of humanistic subjects included in the engineering curricula, and the *extent* of their coordination and integration with these engineering curricula seems still to be much a matter of debate, but the *need* is an accepted fact. Generally speaking, the various opinions advanced on these matters are soundly based and entirely justified, provided full weight is given to the conditions of the individual engineering school where a particular method is being used.

In spite of all the thoroughgoing consideration that has been given to the all-around development of the individual engineering student and the many lengthy discussions that have been held concerning both the fundamental principles involved and also the detailed mechanisms for achieving the results, little attention seems to have been directed to determining whether the study of humanistic subjects provides a fundamental development of the individual student or whether it is somewhat of a superficial intellectual veneer. When we speak of the all-around development of a student, we may use the general and indefinite phrase that "we want to develop his personality." Because the term personality is so indefinite and may mean so many things to different people, we tend to throw this into the discard as being an undesirable term to use in dealing with engineers. Whether or not we are engineers, we rather generally are not satisfied in our discussions unless we define our terms—and personality is intangible and to most of us seems rather undefinable. Yet it has a very definite and strong meaning to all of us, a meaning that is closely related to the individual himself, his inward being, his innermost soul. And unless we can determine whether or how subjects of study affect a student's personality, we can not in any way be sure that they are broadening his view or developing him as a person who will be a useful citizen and a satisfactory member of society.

From a qualitative observation of graduates of engineering schools, it is evident that exposure to humanistic studies has some beneficial effect upon the development of a man's personality. There also appears to be evidence that the closer the coordination of the humanistic studies with the technical studies, and the more thoroughly the humanistic studies are integrated into the engineering curriculum, the greater and more beneficial will be the effect upon the individual student. Many reasons have been advanced to account for this desirable result. Probably all of them are in a large part correct, but probably all of them miss, in some degree, the vital point as to how the humanistic studies affect the inner man.

The personality of a student has been developing from its early days and has been influenced directly by his associates (family, friends, teachers), but through it all there is an influence that we as engineering educators seem inclined to overlook, if not actually to forget—the influence of religion. Religious faith is implanted in each individual as a small child, along with his first toddling steps or even earlier. Religious faith is one of the first things that mothers, either consciously or unconsciously, teach their children. It becomes ingrained in the person. It can not be overlooked. It has a direct and lasting effect on the development of the personality. Religious faith can be dampened until it is fairly non-existent, or it can be nurtured and cultivated into thoroughgoing convictions, based to a large extent upon reason.

Religious faith and religious conviction are an integral and essential part to each and all of us. They have been a stimulating force in the forwarding and developing of civilization through the ages. They must not, therefore, be forgotten or omitted in considering how best to develop the engineering student into full bloom in the engineering profession as a well-rounded and competent individual and a desirable member of society.

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[1] Presented at the meeting of the Illinois-Indiana section, Society for the Promotion of Engineering Education, at the University of Notre Dame, April 20, 1940.

To my mind the education of an engineering student while in college may be considered as falling into three groups or channels: the acquisition of scientific and technical knowledge and training and ability to apply it, a broadening education of humanistic subjects, and the development of religious faith into substantially a reasoned religious conviction. It is a generally accepted practice in engineering schools to include the first two groups in their engineering curricula and to endeavor to bring them into a homogeneous entity, a sort of monolithic slab of engineering education with the humanistic subjects spreading among the scientific and technical subjects and impermeating them as the cement spreads throughout the sand and gravel and binds it together in a single structure. In non-denominational institutions, such as state universities, by our present American practices, religion may not be taught formally to all the students; the students must continue their education in religion on an individual, personal and informal basis with the religious organizations on the campus or with the churches in the vicinity. This makes it difficult, well-nigh impossible, to make their religious training an integral part of their formal education. At the same time their religious convictions are developing and are having strong influence—perhaps stronger than anything else—upon the development of their personality, which in turn will greatly affect their progress and achievement in later life. In my opinion there is strong argument for the taking of courses in religion during college education—courses that will make an intellectual approach upon religion and will aid the student in converting his unreasoned faith, which he has absorbed from parents and church, into a reasoned conviction. In institutions where courses in religion are offered, this result can be achieved by the student himself, but the greatest effectiveness can be accomplished if the religion courses, like the humanistic subjects, are brought into the engineering curricula as an integral and cognate part. The principles brought out in the courses of religion need to be utilized both in the humanistic subjects and in the technical subjects. Especially is this important in the upper class years when we, as engineering educators, are inculcating in our engineering students the ideals of the profession and the ideas of professional ethics.

At the University of Notre Dame, in addition to the requirement of courses in religion, the students have to take certain courses in philosophy. We are utilizing these philosophy subjects to aid us in coordinating the religious principles with the every-day life of the professional engineer. Philosophy may be considered as the bridge or tie between courses in religion and the technical subjects.

I feel that our objective in the engineering college at Notre Dame is to develop fine men who will be excellent citizens and first-rate engineers. I wish to quote from a discussion of the instruction in philosophy that Professor Roemer, of the Notre Dame philosophy department, has presented to me at my request:

> May I be allowed to submit that in this hectic struggle for existence while there is persistent demand for technicians in many fields of engineering, the engineer is apt to forget that before he is a professional man, he is first of all a *man*. If we who claim to be educators and builders of men forget that we are molding the minds and hearts of human beings who, like ourselves, have rights and duties in society, how can we expect our finished product to be complete?
>
> Apart from religious doctrine, there are the cultural disciplines to which an educated man must need have submitted before he can be credited with having developed his intellectual faculty to its maturity. Chief of these cultural disciplines are those of language and those of fundamental philosophy. Here, logic enters so that the future executive may know how to think straight. He should be made familiar with the inductive or scientific method and also something of the purely deductive method which finds exemplification in the philosophy of mind and in ethics.

Before closing I wish to read some excerpts from the report of the Society for the Promotion of Engineering Education, "Committee on Aims and Scope of Engineering Curricula." These excerpts indicate the increasing recognition of the need of dealing with social problems by the engineering profession in general and by the individual engineer.

> From its very nature, engineering education operates under changing conditions which constantly challenge its processes and test its results. Its recent history has therefore been one of continuing appraisal and adaptation to changing needs.
>
> Continuation of this process of self-examination seems now to be called for by new conditions, trends and attitudes that will be readily recognized: (a) The thoughtful public has become aware in recent years of the technological nature of our civilization and of the part that engineers must play in the solution of many of its problems. There is therefore a wide-spread insistence that the technological professions should be competent to evaluate the social problems with which they deal and to recognize the social forces which they create.
>
> There is among engineering colleges a basic uniformity of aims, ideals, methods and standards of undergraduate instruction. This homogeneity is not the result of any imposed standardization; it is derived from a strong sense of solidarity among the different institutions and from the common ends they serve. In these circumstances there is ample opportunity for well-considered variations in curricula and for educational experimentation. . . . Diversity is, in fact, one of the basic characteristics of engineering services.

> Engineering education rests on a foundation of science, of humanities and of social relationships. . . .
>
> First (proposed policy), broadening of the base of engineering education, now in process, should be continued. Its roots should extend more deeply into the social sciences and humanities as well as into the physical sciences in order to sustain a rounded educational growth which will continue into professional life. Two stems are thus implied in the undergraduate curriculum which we have designated as the scientific-technological and the humanistic-social.
>
> The humanistic-social studies should be directed toward (six objectives, one of which is stated as): 5. Development of moral, ethical and social concepts essential to a satisfying personal philosophy, to a career consistent with the public welfare and to a sound professional attitude.
>
> Undergraduate curricula should be made broader and more fundamental through increased emphasis on basic sciences and humanistic and social studies.
>
> No measures taken with respect to engineering education should limit the freedom that now exists for experimentation and change.

Proper consideration of social problems can not be given nor adequate solutions made unless we use the engineering method of obtaining all information pertinent to the specific problem. We do not have all information unless we have an understanding of religious faith and convictions, and their effect upon the actions and viewpoint of individuals. Since the engineer, increasingly in the future, will be concerned with social, in addition to technical and economic problems, it is important for him to have knowledge of religious principles and their result and effect on the individual. This in turn places the charge upon us as engineering educators to determine how far the training in religious principles should be brought into engineering training as a formal part of the curricula. I submit that religious faith and some knowledge of religious principles is ingrained in our students, and for this reason, so far as practicable, definite attention to integrating an intellectual study of religious principles and convictions into the engineering curricula is desirable, if not actually essential, for the best progress of the profession of engineering in its broadening scope in approaching social relationship in the future.

SCIENTIFIC EVENTS

SCIENTIFIC AND TECHNICAL DEVELOPMENTS OF USE IN THE WAR

A SPECIAL cable from London has been received by *The New York Times* which reads:

> The government has set up a scientific brain trust headed by Lord Hankey to give the scientific workers of Britain more scope in inventive prosecution of the war and in countering the enemy's arms. Acknowledged leaders of various branches of science, whose appointment to the new scientific advisory committee was announced to-night, will form a central clearing house for new ideas.
>
> Among the men on the committee are Sir William Bragg, member of wartime committees on food and fuel; Dr. Edward Victor Appleton, radio expert, who was called in by the government before the war to improve civil defense against bombers; Professor Archibald Vivian Hill, one of the world's foremost physiologists and a leading authority on aerodynamics and anti-aircraft defense.
>
> From the public point of view the most immediate problem facing the new body is perfection of a weapon against night bombers.
>
> An important job of the committee is to see that no new scientific or technical developments go neglected. Members will examine original ideas and pick out those they think can be used or developed after experiment. The members also will bring their individual and combined gifts to the services of their country.

A correspondent of the London *Times* writes under date of September 2 that the Canadian Government has announced the appointment of a committee of nine members which will administer the funds presented to patriotic citizens for assisting important technical projects and scientific investigations now being undertaken or proposed by the National Research Council with the object of increasing the efficiency of the Canadian war effort.

The chairman of the committee is Dean C. J. Mackenzie, acting president of the National Council, and the members include Sir Frederick Banting, J. S. Duncan (Deputy Minister for Air), Professor Otto Maass, head of the department of physical chemistry of McGill University, and Colonel Allen Magee, executive assistant to the Minister of National Defense. It is understood that the funds given or promised amount to nearly $1,000,000. The committee is empowered to coopt donors to serve as non-voting members.

DEDICATION OF THE NATURAL RESOURCES BUILDING AT THE UNIVERSITY OF ILLINOIS

ON the occasion of the dedication of the new Natural Resources Building of the University of Illinois on November 14 and 15, the Illinois Geological Survey of the State Department of Registration and Education, the Engineering Experiment Station of the University of Illinois and the Illinois Mineral Industries Committee extend an invitation to all the mineral industries of Illinois and of other states, and to all allied organizations, to join them in holding a mineral industries conference.

The official announcement points out that the completion of the Natural Resources Building promises to begin a new chapter in the development of the state. It is equipped with the most modern facilities for research, with complete offices and laboratories, that will make it possible to pursue research investigations of the natural resources of Illinois that, although planned, until now have had to be postponed for want of adequate facilities.

The Mineral Industries Conference will begin with an open-house gathering on Thursday morning that will afford an opportunity for complete inspection of the new offices and laboratories of the Geological Survey. At noon there will be an all-mineral-industries luncheon followed in the afternoon by concurrent separate sessions on coal, oil and gas, clay and clay products, rock and rock products, and a symposium on "The Geology of the Devonian System" conducted jointly with the department of geology of the university. There will be a general mineral industries banquet on Thursday evening.

In honor of the dedication of the new building, the Industrial Minerals Division of the American Institute of Mining and Metallurgical Engineers will hold its autumn meeting in Urbana and its members will participate in the sessions on clay and rock products. The dedication ceremonies will take place on Friday afternoon under the auspices of the Board of Natural Resources and Conservation and the University Board of Trustees. Dr. Isaiah Bowman, president of the Johns Hopkins University, will give the dedication address.

The Natural History Survey, which shares the building with the Geological Survey, will also sponsor conferences for its allied groups, and they will join in the dedication. State officials will be present and also delegates from leading universities and research institutions of the country, and from various scientific and technical societies.

Following the ceremonies a reception will be held in the foyer of the Natural Resources Building and in the evening all groups will join in a dedication banquet.

NEW DISPENSARIES IN NEW YORK CITY

THE cornerstone laying ceremony at the Kings County Hospital, Brooklyn, N. Y., of the third of a series of ten new modern dispensaries, planned by the Department of Hospitals for different sections of the city, was held on September 25. The speakers were: F. H. La Guardia, mayor of the City of New York; John Cashmore, president of the Borough of Brooklyn; Irving V. A. Huie, commissioner of the Department of Public Works; Dr. Walter A. Coakley, president of the Medical Board; Dr. Emanuel Giddings, medical superintendent, and Rev. Charles E. Schmidt, chaplain. Dr. S. S. Goldwater, who has now retired as commissioner of the department of hospitals, presided.

The building for the dispensary, which will be erected at the cost of a million dollars, will be a five-story, steel-framed structure with concrete foundation and floors, and exterior walls of brick, trimmed with limestone with a granite base.

In a statement made by Dr. Goldwater he pointed out that legitimate demands for the services of the clinic by citizens unable to pay for private medical care continue to increase. As a sample of the increases that have been experienced at all the clinics, he said that at the Kings County Hospital clinic visits had increased from 163,638 in 1933, when the present quarters were first opened, to 358,072 in 1939. He said further:

> The additional space which the new dispensary makes available will greatly facilitate the registration of patients, thereby avoiding the necessity of long hours of standing in line. Provision will be made for registration of double the present number of patients treated daily. Examining rooms will be provided where physicians in light, bright surroundings, unencumbered by the stress of overcrowding, will be able to give better service to the patients. The tuberculosis clinic, now housed in makeshift quarters in the tuberculosis pavilion of Kings County Hospital, will occupy quarters in the new dispensary which will provide a complete set-up for fluoroscopy and collapse therapy. The expanded social service division of the dispensary will provide more privacy and a more cheerful atmosphere for the solution of the many problems of clinic patients. In addition, it will provide more space for the adequate follow-up of venereal, fracture and luetic prenatal cases. Extensive equipment for x-ray and physical therapy will be provided in the building, thus relieving the strain on departments originally intended for hospital service only.

In the development of the dispensaries first relief was sought at Greenpoint Hospital, also in Brooklyn, where a modern building was opened in 1937. The second dispensary in the series was the Welfare Island (Consolidated) Dispensary at East End Avenue and 80th Street, Manhattan, which was opened on August 1 of this year and which serves patients of the three city hospitals on Welfare Island. Other new dispensaries or major additions to present services for the relief of indigent patients have been authorized and planned at Queens General Hospital in Jamaica, Coney Island and Cumberland Hospitals in Brooklyn, Lincoln and Morrisania Hospitals in the Bronx, and Harlem and Bellevue Hospitals in Manhattan.

CENTENNIAL CELEBRATION OF THE COLLEGE OF MEDICINE OF NEW YORK UNIVERSITY

MEMBERS of the Alumni Fund Committee of the College of Medicine of New York University met at a dinner on October 7 in New York City to plan the collection of a fund of $50,000 in preparation for the centennial celebration next year. Dr. Luther B. McKenzie is president of the Medical Alumni Association.

Speakers at the dinner included Dr. Harry Woodburn Chase, chancellor of the university; Dr. Samuel A. Brown, dean emeritus of the College of Medicine; Laurence G. Payson, chairman of the finance committee of the council of the university, and Dr. McKenzie. Dr. Currier McEwen, dean of the college, was toastmaster.

The College of Medicine of New York University opened in October, 1841. It has graduated 10,900 physicians. Approximately 5,000 alumni are now living. One out of each five physicians registered in New York City is an alumnus of the college.

The faculty has grown from a group of eight teachers in the first year to 507 on the instruction and clinical staff for the current academic year. The 1940–41 enrolment is 497 students, nearly ten times the 1841 enrolment of fifty-one students.

From its inception the college has been closely identified with Bellevue Hospital and has recently become affiliated with New York City in the development of a public health program. In addition it has conducted its own clinic for fifty-seven years and last year treated its one millionth patient.

The campaign for the alumni fund of $50,000, which will be used for the purchase of instructional equipment and for the support of the library and other special departments of the college, will be conducted by Dr. McKenzie and a committee of seventy graduates.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

As a result of a letter ballot of the 15,000 members of the American Society of Mechanical Engineers the following officers have been elected: William A. Hanley, director of Eli Lilly and Company, Indianapolis, Ind., and head of its engineering division, *president; vice-presidents* to serve two-year terms on the council: Samuel B. Earle, research engineer and dean of engineering at Clemson Agricultural and Mechanical College, South Carolina; Frank H. Prouty, a partner in the Prouty Brothers Engineering Company and the Industrial Appraisal Company, both of Denver, and Edwin B. Ricketts, mechanical engineer with the Consolidated Edison Company of New York, Inc., New York, N. Y.; managers elected to serve on the council for three-year terms: Huber O. Croft, professor of mechanical engineering and head of the department at the University of Iowa; Paul B. Eaton, consulting engineer and head of the mechanical engineering department at Lafayette College, and George E. Hulse, chief engineer, The Safety Car Heating and Lighting Company, New Haven, Conn.

The new officers will be installed during the sixty-first annual meeting, which will be held at the Hotel Astor, New York City, from December 2 to 6. Headquarters will be at the Hotel Astor instead of at the Engineering Societies Building. The meeting is expected to attract to it about 5,000 engineers and executives from the United States and Canada. More than a hundred technical papers on such specialized mechanical engineering subjects as aeronautics, applied mechanics, fuels, hydraulics, metals engineering, machine-shop practice, management, materials handling, petroleum, steam power, railroads, textiles, heat transfer and process industries, will be presented by leading experts in the field. To accommodate all these papers, forty-four sessions are being arranged, including six on Monday evening, December 2.

At the banquet on Wednesday evening, December 4, two addresses, one by the president of the society, Warren H. McBryde, of San Francisco, and the second by a member of the National Defense Commission, will be made. In addition, President McBryde will present the 1940 awards of the society, including the American Society of Mechanical Engineers Medal, the Holley Medal, the Worcester Reed Warner Medal, the Melville Medal, the Junior Award, the Pi Tau Sigma Award, the Charles T. Main Award of $150, and two Student Awards of $25 each. Tuesday evening will be devoted to an informal, get-together smoker, and Thursday evening to college-reunion dinners.

In addition to the technical sessions programs on "Training to Meet the National Emergency" have been arranged at 9:30 A.M. and at 2 P.M. on Thursday, December 5. The speakers and their subjects will include:

"Training for National Defense," by Dean A. A. Potter, Purdue University.

"Training in Industry to Meet the National Defense Program," by C. R. Dooley, manager of industrial relations, the Socony-Vacuum Oil Company, New York.

"Training College Graduates for the Aeronautic Industry," by H. Randall Irwin, the Lockheed Corporation, California.

"Important Training Being Done at the U. S. Navy Yard," by Captain Lake or Captain Fisher.

"Emergency Training Program Being Carried out at the Rensselaer Polytechnic Institute," by President William O. Hotchkiss and Professor Stanley Wiltse, of the institute.

"Need for Training on College and Sub-College Levels as Seen by the U. S. Civil Service Commission," by E. J. Stocking, of the commission.

SCIENTIFIC NOTES AND NEWS

A BUST of Dr. Albert Einstein has been presented to the University of California at Berkeley. It was given to the university by Hugo D. and Arthur A. Newhouse and was cast in bronze by Frederick W. Schweigardt. It has been placed in the main catalogue room of the library. Dr. Einstein posed for the bust in 1933 when he lectured at the California Institute of Technology in Pasadena.

REAR ADMIRAL RICHARD E. BYRD received from President Roosevelt on September 27 a gold star in recognition of the success of his Antarctic expedition.

DR. WILLARD COLE RAPPLEYE has received leave of absence for fifteen months from the deanship of the College of Physicians and Surgeons, Columbia University, to enable him to succeed Dr. Sigismund S. Goldwater as commissioner of hospitals. The oath of office was administered to Dr. Rappleye by Mayor La Guardia on October 1 in the World's Fair City Hall. Dr. Goldwater resigned recently as commissioner of hospitals to devote full time to his position as head of the Associated Hospital Service.

THE William Lawrence Saunders gold medal for 1941 of the American Institute of Mining and Metallurgical Engineers has been awarded to Herman C. Bellinger, vice-president of operations of the Chile Exploration Company, a subsidiary of the Anaconda Copper Mining Company. Mr. Bellinger, who will receive the medal in February at the annual meeting of the institute, was responsible for electrification of the Chuquicamata Mine in Chile and for the introduction of liquid-oxygen explosives for blasting at the mine. Robert Crooks Stanley, chairman of the board and president of the International Nickel Company of Canada, Ltd., will receive at the same meeting the first Charles F. Rand gold medal "for achievement in mining administration."

AT the recent fiftieth anniversary meeting of the New York State Library Association the guest of honor was Dr. Andrew Keogh, who was until recently librarian of Yale University.

CHARLES W. PATTERSON, registrar of Northwestern University Medical School for twenty-seven years, has been retired with the title associate professor emeritus of pharmacology. He had been associated with the school for forty-seven years.

DR. CHARLES T. CHAMBERLAIN, for many years clinical professor of otolaryngology at the Medical School of the University of Oregon in Portland, has retired with the title emeritus professor of otolaryngology.

DR. M. J. DORSEY, chief of the division of pomology at the College of Agriculture of the University of Illinois, has been appointed head of the department of horticulture. Dr. Dorsey succeeds Dean J. C. Blair, director emeritus, who organized the department and served as its first and only head for forty-three years.

DR. ROBERT D. LEWIS, a member of the department of agronomy of the Ohio State University, formerly professor of plant breeding at Cornell University, has been appointed head of the department of agronomy at the Ohio State University.

DR. JOHN W. CHAMBERLAIN, assistant in the department of hygiene at the Massachusetts Institute of Technology, has been appointed assistant director.

DR. PAUL A. NEAL, surgeon, U. S. Public Health Service, a member of the staff of the National Institute of Health at Bethesda, Md., has been detailed as chief of the division of industrial hygiene of the institute. He succeeds Dr. Royd Ray Sayers, who joined the staff of the U. S. Bureau of Mines several months ago.

DR. WILLIAM C. SENNING, of Cornell University, has been appointed head of a new research station established by the New York State Conservation Department at the University of Rochester, to improve production and management of fish in the Finger Lakes region and westward.

DR. GEORGE B. DARLING, associate director, and Dr. Emory W. Morris, associate executive director, of the W. K. Kellogg Foundation at Battle Creek, Mich., have been elected, respectively, president and general director, succeeding the late Dr. Stuart Pritchard, who held both positions.

DR. HELLMUT DE TERRA, research associate of the Carnegie Institution of Washington, has been appointed associate professor of geography at the New School for Social Research, New York, by special grant from the Rockefeller Foundation.

DR. ROBERT A. JEHLE, specialist in plant pathology for the University of Maryland Extension Service, has been appointed professor of plant pathology at the university and state plant pathologist. He succeeds Professor Charles E. Temple, who retired on October 1.

DR. OTTO HAAS, of Vienna, is cooperating as a volunteer worker in a research project based upon the collections of invertebrate fossils with members of the staff of the departments of geology and zoology at the Field Museum, Chicago.

F. C. BAWDEN, in charge of investigations on virus diseases of plants, has been appointed head of the department of plant pathology at the Rothamsted Experimental Station at Harpenden, in succession to Dr. J. Henderson Smith, who is retiring after having held the post since 1932.

C. VERNON HOLMBERG, assistant in research sponsored by the Technical Association of the Pulp and Paper Industry at the New York State College of Forestry, spent the summer in research on wood waste utilization at the Miner Laboratories, Chicago.

A GRANT of $2,760 has been appropriated by the National Foundation for Infantile Paralysis (the President's Birthday Fund) for research by Dr. John A. Toomey, associate professor of pediatrics (contagious diseases) of the School of Medicine of Western Reserve University. It is to be used to find a method of producing infantile paralysis in the smaller animals. Dr. Toomey has previously received grants from the National Foundation amounting to $48,000 for his experiments in infantile paralysis at the City Hospital.

BY an Order of the Committee of the British Privy Council the Rt. Hon. James Gray Stuart has been appointed a member of the Medical Research Council in the vacancy caused by the resignation of R. K. Law, M.P. By another Order, made after consultation with the Medical Research Council and with the president of the Royal Society, Sir W. Wilson Jameson, dean of the London School of Hygiene and Tropical Medicine, has been appointed a member of the council in succession to Professor Matthew J. Stewart, professor of pathology at the University of Leeds, who retired in rotation on September 30.

SIR ARTHUR HURST gave the eighteenth Norman Kerr Memorial Lecture before the Society for the Study of Inebriety, London, on October 8. His subject was "Alcohol and the Organs of Digestion."

THE two hundred and thirty-seventh regular meeting of the American Physical Society will be held at the University of Chicago on Friday and Saturday, November 22 and 23. Other meetings for the current season are as follows: Pacific Coast meeting, Pasadena, Calif., December 20 and 21; annual meeting, Philadelphia, December 26 to 28; Cambridge, February 21 and 22; Washington, D. C., May 1 to 3, 1941; Providence, June 20 and 21, 1941.

THE Michigan-Indiana-Ohio Museums Association will hold its thirteenth annual meeting at Toledo, Ohio, on October 17, 18 and 19. The Toledo Museum of Art and the Toledo Zoological Gardens will be hosts for the meeting.

THE first meeting of the 1940–41 season of the Mid-West Section of the American Association of Cereal Chemists was held on October 7, with dinner at Somerset Poultry Farm Restaurant, Lyons, Ill. A short business session was held, after which J. M. Mercer, junior department engineer, Sanitary District of Chicago, spoke. The speaker took as his subject "A Half Century of Water Supply Practice for Chicago." An inspection trip through the main sewage disposal plant followed. Announcement is made that at the Tri-Sectional meeting at Urbana on November 9 the Mid-West Section will supply two speakers. Immediate past president of the national organization, George Garnatz, of the Kroger Grocery and Baking Company, Cincinnati, Ohio, will be the guest of honor.

THE fifth annual meeting of the Carolina Geological Society will be held at Bond Hall, The Citadel, Charleston, South Carolina, on October 19 and 20. Under the leadership of Professor J. H. Watkins the following places will be visited: on October 19 the Charleston Museum; Earthquake Evidence; Old Dorchester Road; Dump Shaft No. 11; Edisto-Goose Creek Tunnel; Summerville; Givhans State Park; Bee's Ferrybridge. There will be dinner at the Citadel Mess Hall at 7:30 P.M., which will be followed by a business meeting in the Physics Lecture Room. General Summerall will address the society at dinner. On Sunday there will be trips to the Santee-Cooper Project and to Eutaw Springs.

MEMBERS of the American Society of Naturalists are asked to submit nominations for new members to the secretary before the close of the forthcoming annual meeting. According to the constitution, nominations must be received before this time in order to be eligible for election in December, 1941. The secretary is Dr. Ralph E. Cleland, department of botany, Indiana University, Bloomington, Ind.

DR. ROY CHAPMAN ANDREWS, director, has announced that visitors admitted to or remaining in the American Museum of Natural History, New York, after 5 P.M. will be required to identify themselves. Identification may be established by showing to museum guards membership, registration or other cards indicating affiliation with the particular activity or agency using the museum premises. Those admitted to or remaining in the museum after 5 P.M. are expected to confine themselves to that part of the building designated for the activity for which they are admitted. It is understood that the rule will be applied gradually and discreetly, so that no person with legitimate business after hours will be embarrassed or inconvenienced. This request of the museum in no way indicates that friends of members may not attend meetings also, but should they do so, it is hoped that they will be prepared to prove their contact with a particular member and occasion. Members of the New York Academy of Sciences are, therefore, requested to carry their current membership cards when attending meetings, and to be prepared to show them to museum attendants if requested to do so.

REPORTS received by the editors of *Chronica Botanica* stated that the collection of cultures of the Central Bureau of Fungus Cultures in Baarn, Holland, is in excellent condition and has not been damaged by the war. Shortly before the invasion of the Netherlands tentative plans had been made to transfer part of this collection to the United States, as it contains many types of great importance to American mycologists and phytopathologists.

ACCORDING to the *Journal* of the American Medical Association, the medical department of the University of Chicago eventually will receive all of the estimated $100,000 estate of the late William O. Oppenheim. Under a trust established by the will, the income will go to relatives during their lifetime.

IT is reported that the construction of a new library in the Harvard yard, to house rare books and manuscripts and to provide exhibition and study rooms for important collections, will be begun this autumn. The new building, 55 by 120 feet, will be situated east of Widener Library. It will be of Georgian style, brick and limestone, three stories above ground, housing more than a quarter of a million volumes. The structure has been made possible through the support of an anonymous alumnus. One of the most important collections of sixteenth and seventeenth century material in the United States, now in Widener Library, and all the books in the Treasure Room will be moved there. This transfer will relieve in part the critical shortage of space in the library.

NOMINATIONS are solicited for the 1941 award of $1,000 established by Mead Johnson and Company to promote researches dealing with the B-complex vitamins. The recipient will be chosen by a Committee of Judges of the American Institute of Nutrition and the formal presentation will be made at the annual meeting of the institute at Chicago on April 16, 1941. The award will be given to the laboratory or research worker in the United States or Canada who, in the opinion of the judges, has published during the previous calendar year the most meritorious scientific report dealing with the field of the B-complex vitamins. Membership in the American Institute of Nutrition is not a requisite of eligibility for the award. Nominations for work published in 1940 must be in the hands of the secretary by January 25, 1941. They should be accompanied by such data relative to the nominee and his research as will facilitate the task of the committee in its consideration of the nominations. Correspondence should be addressed to Dr. L. A. Maynard, secretary of the American Institute of Nutrition, Laboratory of Animal Nutrition, Cornell University, Ithaca, New York.

THE *Journal* of the American Medical Association states that the Chicago Heart Association, Inc., has received from the Clara A. Abbott Trust a gift of $27,000 to be added to the Memorial Fund founded in memory of Morris Fishbein, Jr. The money is to be used either by itself or with other funds of the society for the study and treatment of diseases of the heart and the circulation. A fellowship is to be established in a hospital or medical school in Chicago, which will be devoted primarily to the study of the cause and treatment of rheumatic fever. The Clara A. Abbott Trust has already donated millions of dollars to the University of Chicago, to Northwestern University and to the Evanston Hospital, since the purpose of the Clara A. Abbott Trust is to aid the care of the sick and the advancement of medical science. The Memorial Fund of the Chicago Heart Association, now almost $40,000, was established in 1929 by Dr. Morris Fishbein, editor of the *Journal* of the American Medical Association, and Mrs. Fishbein, at the time of the death of their son from rheumatic fever. The fund is administered by a self-perpetuating committee of five, including Drs. Robert B. Preble, Newell C. Gilbert, James B. Herrick, Walter W. Hamburger and Morris Fishbein.

THE *Lancet* reports that the outbreak of war had an unfortunate paralyzing effect on organized medical research, more particularly on the work of the special institutes in London whose staffs were dispersed to the various sectors or to emergency public-health laboratories throughout the country. The Lister Institute, with the exception of its biochemical and biophysical departments, shared in the general exodus, but it had at Elstree a country home for its bacteriological staff, the division of nutrition was accommodated at Cambridge, while individual members of the staff found refuge in other research institutes. As a result, the latest annual report, giving an account of the extensive researches in bacteriology, nutrition and biochemistry of the institute, bears little imprint of disorganization.

DISCUSSION

EDUCATION AND PARTICIPATION IN SCIENCE

LAYMEN scientists or amateurs from time to time have made important contributions to research in the physical and natural sciences. Such persons, although lacking professional training, often become experts in their field and learn the spirit and method of science through actual apprenticeship. To test the effectiveness of such work on the part of amateurs, as well as to bridge the gap between the general public and pure research, has been the purpose of a program in the Philadelphia area conducted by the Committee on Education and Participation in Science under the supervision of The American Philosophical Society since June, 1939. The grant from the Carnegie Corporation of New York, which has made this work possible, was renewed to extend until June, 1941. The members of the society who comprise the committee are: Dr. E. G. Conklin, *chairman;* Dr. Anton J. Carlson, Dr. Karl K. Darrow, Dr. Luther P. Eisenhart, Dr. C. E. Kenneth Mees, Dr. Oscar Riddle, Dr. Harlow Shapley, Dr. George G. Simpson, Dr. W. F. G. Swann, Dr. Edward L. Thorndike, Dr. Harold C. Urey and Mr. Roland S. Morris, president of the American Philosophical Society. For the past fourteen months, the committee has made an intensive survey of the amateur scientific movement through both questionnaires addressed to individuals and a study of amateur clubs and societies. The results of this work are now being prepared for publication in the form of a pamphlet entitled, "The Layman Scientist in Philadelphia: A Directory of Amateur Scientific Organizations and Resources in Science."

More recently, beginning April 1, 1940, a series of programs has been carried out by the committee whereby amateur scientists in the Philadelphia area, working on a voluntary basis, are making original observations and compiling data in the fields of botany, climatology, physics and radio, and zoology under the supervision of professional scientists. These consultants are attached to the committee's executive staff. In botany, eighty laymen observers in suburban localities near Philadelphia have been engaged in a phytophenological study. In the course of this work they have recorded, in systematic form, the opening of petals, the shedding of pollen and the maturing of fruit of some 115 of local spring and summer wild flowers. The records included weather observations and other notes which were made on mimeographed charts supplied by the committee. The study was planned and directed by Dr. John M. Fogg, Jr., assistant professor of botany of the University of Pennsylvania and consultant to the committee. At the same time, another group of men and women, under the supervision of Dr. Edward E. Wildman, of the Philadelphia Board of Education and also a staff member, are participating in a study of tree ring growth in relation to the climate of the Delaware Valley included in eastern Pennsylvania, southern New Jersey and parts of Delaware and Maryland. Over one hundred individuals have already supplied data on the location of stumps and cross-sections of trees one hundred years or more in age. Some of the participants have made paper strip records indicating the relative thickness of the growth rings, not only in tree stumps but of the cross-sections from timbers of ancient dwellings. It is planned that the information will be collected and used in the compilation of master charts which will be available for study by professional dendrochronologists. The committee issues, from time to time, a mimeographed "Tree Ring Log" which contains letters and notes from the amateurs engaged in this project as well as information concerning old diaries, letters and newspaper accounts which reveal the past weather history of the Philadelphia region and which are being uncovered by volunteer students.

Radio communication and a phase of its relation to physics concerns the third project for laymen volunteers. This program, under the direction of Dr. Serge A. Korff, of the Bartol Research Foundation and consultant in physics and astronomy to the committee, involves a study of the ionosphere or Heaviside layer. Amateur radio operators who agree to cooperate filll out charts with technical information concerning receptions, fade-outs, skip-distance records and other data obtained in the course of their normal contacts. More than two hundred persons have commenced active participation in this study and have sent in several hundred important records. One member of the group contributed many hours of his time in compiling the data already accumulated, which will eventually be used in the ionosphere investigations carried on by Dr. L. V. Berkner, of the Carnegie Institution of Washington.

A fourth experiment for the Philadelphia amateurs has been undertaken in the field of zoology under the leadership of Mr. Roger Conant, of the committee's executive staff, who is also curator of the Philadelphia Zoological Garden. During the past summer some thirty amateur naturalists have made intensive local studies of reptiles, amphibians and insects by tagging or otherwise marking them and studying their feeding, growth, mating and other habits. In some cases these studies have involved the devising of original techniques on the part of the volunteers. Frogs and turtles have been the animals most frequently employed.

In all these programs the work has been entirely voluntary. Close touch is kept with the various persons who cooperate and informal meetings and discussions are held by the scientists of the committee's executive staff who supervise the projects. The volunteers represent dwellers in urban and suburban communities with varied occupations and interests, including business men, stenographers, engineers, housewives, teachers and others. The amount of time devoted to this work attests to the enthusiasm which has been aroused. Many of the persons taking part have expressed their satisfaction in being permitted to do experimental work in some field of science, even if the duties often comprise the laborious one of making detailed observations and recording data. Since June, 1940, four radio talks have been presented by the consultants of the executive staff. These talks on various phases of the committee's programs for amateurs included two nation-wide broadcasts in cooperation with the series of "Adventures in Science" of Science Service on the Columbia Broadcasting System. One result of these talks and other forms of publicity has been an increasing interest in amateur scientific programs for other sections of the country. Starting in October the committee will resume the monthly publication of its circular, "Activities in Science in the Philadelphia Area," which lists a variety of educational opportunities in the physical and natural sciences, such as lectures, demonstrations, field trips, exhibits and radio broadcasts. It also includes notices of the regular meetings of the forty amateur scientific societies in the region. An interesting development of the activities of the committee has been the formation of the Philadelphia Council of Amateur Scientists which will hold its first formal meeting on September 23. Delegates from all the active groups will be present.

Further information concerning the American Philosophical Society's Committee on Education and Participation in Science can be obtained from W. Stephen Thomas, Executive Secretary of the Committee, The American Philosophical Society, 104 South 5th Street, Philadelphia, Pennsylvania.

W. STEPHEN THOMAS

VEGETATION TYPE MAPS OF CALIFORNIA AND WESTERN NEVADA

IN order to obtain information needed in a variety of administrative and research problems, the Forest Survey Division of the California Forest and Range Experiment Station[1] has for some years been mapping the natural vegetation resources of California and western Nevada. Twenty-one of the map units have been published to date.[2] Each unit consists of a standard 15- or 30-minute U. S. Geological Survey topographic quadrangle (approximately 1- or ½-inch to the mile, respectively) on which symbol and color overprints have been placed to show, as far as the base permits, the present dominant vegetation just as it occurs on the ground. On wide margins are the legend; brief descriptions of the type classification basis and the various types found on the quadrangle; a table summarizing the type areas by counties, national forests and parks; and a profile illustrating the relationship of types to elevation and slope exposure.

Plant associations, based upon dominant species composition, comprise the primary vegetational elements mapped. These are shown in their actual relation to the topography, with symbols identifying the species involved. Any species is considered a dominant if it forms 20 per cent. or more of the total vegetation cover in associations that are wholly herbaceous, shrubby or arborescent; or like percentages of its respective class in composite associations. These percentages are applied only to the vegetation visible from above, however, since the mapping is done externally. The associations are segregated according to general similarities of use, economic importance and fire-hazard characteristics into broad types, which are designated by colors. Three of these types are classed as herbaceous, 5 as shrubby, 4 as broadleaved tree, and 10 as coniferous tree. Also shown are barren, semi-barren and desert areas, cultivated and urban lands and tree plantations.

A considerable amount of basic information concerning the present vegetation resource is thus made available for ready use. The color designations alone are ample for many purposes in which only broad classes of vegetation are involved. If it should be necessary to modify the grouping or to obtain certain details of species composition, the individual associations and their included symbols may be used. In either case the distributions may be studied in relation to location and area occupied, elevation and slope exposure. Although successional positions are not directly indicated, a knowledge of the ecological relationships of the local flora will provide the clues for such a classification.

This flexibility opens up a wide range in usefulness. In California, the maps have had important parts in many projects dealing with the protection, management and utilization of the resource they depict, and in botanical, zoological, ecological and geographical studies as well. For classroom study and demonstration their use has been wide-spread. As the significances of the different elements making up the resource become better understood, these and other uses will grow. Whatever may be lost through lack of agreement with actual conditions after vegetational changes have occurred will be more than compensated by the increasing value of a record against which conditions of the future may be compared.

Other maps of this series will be published as rapidly as funds become available for that purpose.

H. A. JENSEN

CALIFORNIA FOREST AND RANGE
EXPERIMENT STATION

SEX VARIATION IN THE UTILIZATION OF IRON BY ANEMIC RATS

IN the issue of SCIENCE for June 28, 1940, Dr. Mary Swartz Rose calls attention to our article entitled

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[1] Maintained by the U. S. Department of Agriculture at Berkeley, Calif., in cooperation with the University of California.

[2] Obtainable at the cost of printing from the University of California Press, Berkeley, Calif.

"Further Evidence of Sex Variations in Utilization of Iron by Anemic Rats," and states that the findings of the authors, Drs. Louise Otis and Margaret Cammack Smith, "were previously established by Dr. Helen Hubbell and reported in the *Journal of Nutrition* in January, 1938, Vol. 15, pp. 91–102." In this connection we would like to point out that in the course of an investigation using hundreds of rats, begun in 1935 in our Arizona laboratories on the hematopoietic value of foodstuffs, a marked difference in the response of male and female rats was consistently noted. At that time it was current practice in other laboratories to use male and female rats interchangeably, which gave conflicting results. Our findings were reported in a paper by Smith and Otis entitled "Sex Variations in the Utilization of Iron by Anemic Rats," which appeared in SCIENCE in January, 1937, Vol. 85, pp. 125–6, which was almost a year before the paper by Rose and Hubbell appeared. Also, a paper by Smith and Otis entitled "Hemoglobin Regeneration in Anemic Rats in Relation to Iron Intake," which included a discussion of their findings concerning sex difference, was published in the *Journal of Nutrition,* Vol. 13, pp. 557–82, in June, 1937.

We regret that in our third paper, entitled *"Further Evidence* of Sex Variation in Utilization of Iron by Anemic Rats," which is the paper to which Dr. Rose refers, no mention was made of the excellent paper of Rose and Hubbell. It would, of course, have been included in any complete review of the literature on the subject, but a review of any length is not permitted in SCIENCE. A more complete description of our iron studies is soon to appear elsewhere.

MARGARET CAMMACK SMITH
LOUISE OTIS

ARIZONA AGRICULTURAL EXPERIMENT STATION

SUGGESTIONS REGARDING A PROPOSED STANDARDIZATION OF OSMOTIC PRESSURE AS A TERM

THE proposal to standardize osmotic pressure as a term made recently in these columns[1] should meet with sincere approval. We believe, however, that such a standardization should, if possible, transcend the limits of one field of science. This is particularly necessary from a pedagogical standpoint.

As pertinent to this suggestion we would call attention to the desirability of considering osmotic pressure as the pressure that must be exerted on the solution in order to make the escaping tendency of the solvent from the solution equal to the escaping tendency of the pure solvent at the same temperature. One needs further to point out that (*a*) the addition of a solute to a solvent in general lowers the escaping tendency of the solvent molecules and (*b*) the application of an external pressure in general increases the escaping tendency of the solvent. This treatment of osmotic pressure is quite generally found in the better elementary text-books of chemistry, in the physical chemistry texts and in advanced texts.[2]

It will be observed that the suggested standardization includes the two generalizations regarding the influence of solute concentration and pressure. We propose (1) that the definite relation between these generalizations and the osmotic pressure be pointed out and (2) that reference be made to some generalized term such as "escaping tendency."

We suggest that such an amplification would improve the treatment of the term by increasing the range of applicability and by relating the phenomenon under consideration to others, such as vapor pressure effects, etc.

W. H. HALL

BOWLING GREEN STATE UNIVERSITY

SCIENTIFIC BOOKS

LIFE ON OTHER WORLDS

Life on Other Worlds. By H. SPENCER JONES. New York: The Macmillan Company. 1940.

FOR centuries man has wondered and speculated about the possibility of life on other worlds. Nowadays probably no question is put more frequently to the astronomer by the layman than "Are there men on Mars?" Percival Lowell at the close of the past century thought he had evidence for the existence of intelligent life on Mars. Alas, the modern astronomer can not concede Lowell's point. H. Spencer Jones, Astronomer Royal of England, in his recent book, "Life on Other Worlds," brings a timely and authoritative account of many aspects of the problem of the existence of life elsewhere in the universe.

Regardless of whether or not life does exist on the other planets, life can be directly observed only on the Earth. Life as we know it must therefore furnish a working definition of what shall constitute life. Complex molecules containing carbon have been found to form the basis of the structure of all living organisms on Earth. From the prevalence of the same physical and chemical laws throughout the universe, Dr. Spencer Jones consequently infers that the formation of similar large molecules with chainlike structure and of feebly stable molecular groups must be possible wherever living matter is to exist, although the living matter need not necessarily be of a type familiar on Earth. A study of the physical, meteorological and geological conditions and their evolution on the Earth make it evident that the requisites for the existence of life (especially regarding atmospheric composition and temperature) are rather narrowly defined. Spencer Jones, discussing at length all the planets and the principal satellites of the solar system, finds evidence for vegetation on Mars, but no evidence anywhere for animal life. With the possible exception of Mars, the Earth is, he contends, the only planet on which animal life can have developed.

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[1] H. C. Eyster, SCIENCE, 92: 171–2, 1940.

[2] The following list includes an example from each of the classes mentioned: Herman T. Briscoe: "An Introduction to College Chemistry," p. 257. Houghton Mifflin Company. W. H. Rodebush and E. K. Rodebush: "An Introductory Course in Physical Chemistry," p. 188. D. Van Nostrand Company. G. N. Lewis and Merle Randall: "Thermodynamics and the Free Energy of Chemical Substances," p. 213. McGraw-Hill Book Company.

Speculatively the author also takes us beyond the solar system. Considering the nicety of conditions required for the existence of life, may we egotistically assume that we are the only men in the universe, or must we modestly admit that our Earth is but one among innumerable similar satellites to other suns? That, according to the Astronomer Royal, depends very much on how the solar system originated. Many theories have been proposed, but all, on careful examination, have been found wanting. The most promising theory requires such specialized accidental circumstances that our egotism is encouraged. On the other hand, he points out, the immensity of the number of galaxies of stars and the theory of an expanding universe combine to suggest that ours is not a unique world.

"Life on Other Worlds" gives a fairly complete survey of the present state of knowledge on the subject. It is fluently and clearly written. In general, the treatise is not only instructive but entertaining (notably where the fates of would-be rocket exploring-expeditions to the Moon are commented upon) and it is definitely provocative of thought. The reader is left impressed with the quantity of research in numerous fields of science that has been accomplished in an approach to the solution of the problem of life elsewhere in the universe. "Life on Other Worlds" is sincerely recommended to all astronomically and philosophically minded laymen. For the astronomer it will provide an enjoyable "busman's holiday."

Dorrit Hoffleit

Harvard College Observatory

MEDICINE IN AVIATION

Grundriss der Luftfahrtmedizin. By Siegfried Ruff and Hubertus Strughold. viii + 191 pp., 103 figs. Leipzig: Johann Ambrosius Barth, Verlag. 1939.

The preface to this book is written by Dr. E. Hippke, "Chef des Sanitätswesens der deutschen Luftfahrt." Chapter I reviews the problems which meet the aviator and alpinist as higher and higher altitudes are reached. Chapter II contains an analysis of different factors affecting the organism in high altitude: the low pressure of oxygen, the low temperature, the ultra-violet radiation, etc. A short review of the general physiological and physical background necessary for understanding the special physiology of high altitude is given in the first part of the chapter; later follow descriptions of the effects on organs and functions and of ways for investigating and combating the impairing forces. Problems of practical importance, as acclimatization to high altitude, high altitude tolerance, oxygen administration, etc., are given special consideration. Chapter III deals with acceleration. In this field, new as it is, the Germans are specialists in research and in the application of research. Centrifugal force has been studied both "artificially" by means of great centrifuges and "naturally" in various kinds of diving, "pull-outs," "looping," etc. Air-sickness is considered in this chapter. Chapter IV covers the psychophysiology of aviation, especially sensory physiology. In Chapter V the reasons for accidents in flying are analyzed and devices apt to diminish them described, and in Chapter VI is given a short but inclusive review of the comparative physiology of flying.

The book is offered as a supplementary text for students of medicine and as a source of orientation and information for practical men—aviators, military men, physicians and people interested in the problems of the man in the air force. Most figures, tables, curves, etc., are taken from German sources. An English translation might properly include a supplementary chapter or appendix containing data from American and other sources. A revision of the bibliography along the same lines also would seem advisable.

E. Asmussen
D. B. Dill

Fatigue Laboratory, Harvard University

CHEMISTRY IN WARFARE

Chemistry in Warfare. By F. A. and M. S. Hessel and Wellford Martin. With a foreword by Colonel Crosby Field and a Technical Appendix. New York: Hastings House, 135 Front St. 164 pages; numerous illustrations and diagrams; price, $2.00. 1940.

This popular treatment of the subject is clearly and interestingly written. Its purpose is to give the layman a concise and reasonably comprehensive review of the manifold ways in which modern warfare is dependent upon chemistry and the chemist, with such illustrations, diagrams and collateral information as will enable any one to see for himself the significance of chemistry's rôle and the indispensability of the chemist in any program of preparedness and defense.

The subject-matter is assembled under the following chapter headings: I. The Soldier, II. Man-made Man-killers, III. Machines of Modern Warfare, IV. Crucibles of Death (warfare with toxic chemicals), and V. The Chemical Industry—America's First Line of Defense.

The book is not written for chemical or military experts, and such may find minor flaws here and there but, in the opinion of the reviewer, it fulfils creditably its mission of presenting the subject to the uninitiate in a form which he can assimilate with ease and satisfaction and which will equip him to follow more intelligently the war news of the day. If he is a military man, it will teach him something about chemistry. If he is a chemist, he will gain some useful elementary knowledge of military equipment and tactics.

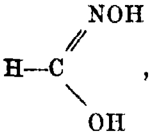
MARSTON TAYLOR BOGERT

COLUMBIA UNIVERSITY

SPECIAL ARTICLES

A NEW CHEMICAL REACTION WITH THE NITROSYL RADICAL NOH[1]

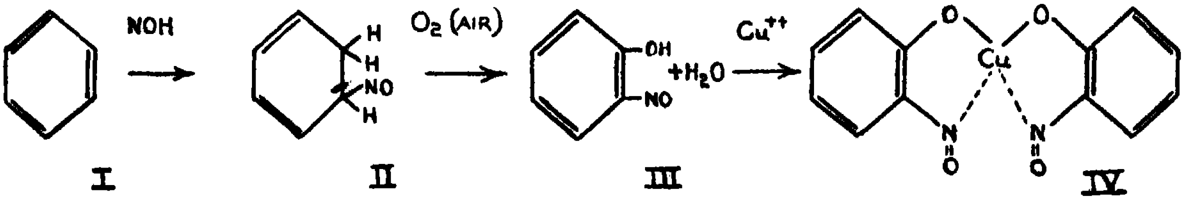
MANY years ago I made the assumption that the nitrosyl radical, NOH, functions as the most important compound as far as the nitrogen in the synthesis of simple naturally occurring, carbon-nitrogen containing material is concerned.[2] It acts as a branching-point, leading to several series of compounds. The most important organic compounds synthesized by sunlight from KNO_2 and methyl alcohol or formaldehyde, which we have analyzed, are formhydroxamic acid,



$$H-C\begin{matrix} /\!/ NOH \\ \backslash OH \end{matrix}$$

, and formaldoxime, $CH_2=NOH$.

It was of special biochemical interest and importance to find other reactions involving nitrosyl. It was to be assumed that the strongly paramagnetic radical, NOH, would combine with inserted paramagnetic ethylene groupings which are present in the benzene ring and in many substituted benzene compounds.



In my recent experiments with hydroxylamine-hydrochloride, copper ions and benzene,[3] nitrosophenol copper salt (IV) was easily formed by autoxydation of the reaction mixture or still better by adding hydrogen peroxide. This remarkable reaction has since been successfully applied by us to many aromatic hydrocarbons and to a great number of substituted benzene compounds, of which more will be said in another journal.

In this publication I will demonstrate that two groups, namely, NO and OH, can be substituted in benzene in a new, amazingly simple way at ordinary temperature. I will further try to elucidate the mechanism of the new chemical reaction with the radical NOH—a chemical process which will have a wide application in chemistry.

Exp. 1

0.5 g freshly prepared yellow cuprous hydroxide, CuOH, is suspended in 200 cc dist. water in which 0.5 g KNO_2 is dissolved (pH 9.9). Purest benzene is added and the solution well stirred. With dilute hydrochloric acid the pH is now adjusted to 2.5 and then 1 cc Merck's superoxol is added. The pale yellowish color changes immediately to pink and becomes deep red after longer stirring. The deep red *o*-nitrosophenol coppersalt (IV) forms *o*-nitrosophenol (III) on acidifying with HCl which can easily be extracted with petrol ether. The petrol ether solution is a beautiful green.

Exp. 2

0.5 g KNO_2 and 1 g cupric nitrate are dissolved in 200 cc dist. water ($pH = 5.6$). Purest benzene is now added to the pale green solution and the whole mixture well stirred. On adding 1 cc Merck's superoxol the color remains green but becomes only a little darker. Now 0.5 g iso-ascorbic acid (or vitamin C) is added. The color immediately changes to pink and becomes deep red on further stirring ($pH = 3.4$), thus forming again *o*-nitrosophenol coppersalt (IV).

Exp. 3

0.5 g freshly prepared cuprous hydroxide is suspended in 200 cc dist. water in which 0.5 g benzene-sulfohydroxamic acid was dissolved ($pH = 4.4$). Purest benzene is added and the whole mixture well stirred. The pH is now adjusted to 2.9 by adding dilute hydrochloric acid. The solution quickly turns pink by autoxydation. By adding 1 cc Merck's superoxol a deep red color immediately appears. After one hour stirring, the red solution is acidified with dil. HCl and extracted with petrol ether. The now deep green petrol ether contains pure *o*-nitrosophenol. The aqueous layer remains deep red. It contains coppersalt of *o*-nitrosophenol sulfinic acid (see exp. 4).

---

[1] Part of the lecture presented at the A.A.A.S. symposium at Gibson Island, Maryland, July 22–26, 1940.

[2] Collected literature of the subject: Oskar Baudisch u. Lars A. Welo; *Chem. Rev.*, Vol. 15, no. 1, 1934.

[3] *Naturwissenschaften*, 27: 768–9, 1939; *Chem. Abstracts*, 34: 1976, 1940.

Exp. 4 (without benzene)

0.5 g cuprous hydroxide is suspended in 200 cc dist. water in which 0.5 g benzene sulfo-hydroxamic acid was dissolved (pH = 4.4). The pH is now adjusted to 2.9. After putting 1 cc Merck's superoxol in the well-agitated solution, the brownish liquid turns deep red with a violet tint. After one hour, the liquid is acidified with HCl and shaken with petrol ether. Nothing goes into the petrol ether and it remains colorless. With ether, however, the *o*-nitrosophenol sulfinic acid can be extracted. The yellowish green ether solution gives characteristic colors with many metals, just like the free *o*-nitrosophenol. Deep red copper, green ferrous, greyish brown cobalt, red nickel and red mercury salts are formed.

From the four experiments described, one can notice that the radical, nitrosyl, has been formed in three different ways—(1) oxidation of $NH_2OH \cdot HCl$ with cupric ions, forming cuprous ions; (2) reduction of HNO_2 with cuprous ions; (3) NOH released from benzenesulfo-hydroxamic acid by adding copper ions plus H_2O_2.

In experiment 3, the NOH is partly captured by the benzene present in the reaction mixture and, therefore, *o*-nitrosophenol copper besides red *o*-nitrosophenol sulfinic acid copper is formed. On acidifying, the *o*-nitrosophenol goes easily into petrol ether while the free *o*-nitrosophenol sulfinic acid is only soluble in ether or ethylacetate.

In experiment 4, the NO and OH substitute hydrogen atoms in the benzene ring of the formed sulfinic acid (the exact position of the chelate NO–OH grouping will be later determined).

Without going into detail here as to the mechanism of the reaction, I assume that primarily both NOH and benzene (toluene, ethylbenzene, xylene, etc.) are coordinately linked to the cuprous ion and thus activated by rearrangement of the the electronic system. The whole reaction occurs, so to say, in the inner sphere of the Werner copper complex, which might be a cuprous or a cuprous-cupric complex. However, only the cuprous central atom of the complex seems to be able to link benzene coordinately. On oxidation to the cupric form it is again released. The reaction between the activated benzene and nitrosyl could be written schematically in the following way:

Compound II is autoxidizable and forms Compound III. The cuprous-cupric complex is stable only in a small range of pH (2.1–4), and in this pH range the best results are obtained. Addition of small amounts of acetone or acetonylacetone to the reaction mixture prevents the formation of *o*-nitrosophenol from benzene entirely. By using the new reaction, we have already synthesized about sixty new *o*-nitrosophenol compounds, all of which show the characteristic of the chelate grouping, ortho NO–OH, towards metals. At the same time many interesting properties are developed by the different substitutes in the benzene ring in different (*o.m.p.*) positions of which we will have more to say in another paper.

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THE FUNCTIONS OF DIPHOSPHOTHIAMINE (PHOSPHORYLATED VITAMIN B_1)

In 1937, Lohmann and Schuster[1] identified *cocarboxylase* as diphosphothiamine. This important discovery, coupled with the work of Peters and his collaborators[2] on the necessity of vitamin B_1 for oxidation of pyruvate by the brain of avitaminotic pigeons, brought one more vitamin within the group of enzyme components. Soon after Lohmann's discovery, Lipmann[3] demonstrated that diphosphothiamine is one of the components of α-ketonoxidase, and Barron and Lyman[4] found that diphosphothiamine acted in animal tissues and bacteria as a catalyst not only for the decarboxylation and oxidation of pyruvate, but also for its dismutation.

The mechanism of this catalysis is still unexplained. It does not seem to be a reversible oxidation-reduction system, as riboflavine and nicotinic acid derivatives were shown to be, although such a theory was suggested by Lipmann.[5] In fact, a comparative study of the rates of reduction and reoxidation of thiamine and diphosphothiamine has shown that the vitamin becomes with phosphorylation more resistant to the action of reducing and oxidizing agents (Barron and Lyman[6]). Nor does it seem to act according to Langenbeck's theory,[7] for Stern and Melnick[8] have presented evidence against a "Langenbeck cycle" involving the amino groups in the pyrimidine ring. The multiple catalytic functions of diphosphothiamine suggest the possibility that it acts by forming the integral part of the activating protein of the enzyme systems concerned with the activation of pyruvate. Once the pyruvate is activated, it may react with catalysts for its oxidation, reduction, dismutation or condensation. This hypothesis need not postulate reversible oxidation-reduction; it predicts, on the other hand, more catalytic functions for the vitamin than those hitherto known.

---

[1] K. Lohmann and P. Schuster, *Biochem. Zeits.*, 294: 188, 1937.

[2] R. A. Peters, *Chem. Weekblad*, 34: 26, 1937.

[3] F. Lipmann, *Nature*, 140: 25, 1937.

[4] E. S. G. Barron and C. M. Lyman, *Jour. Biol. Chem.*, 127: 143, 1939.

[5] F. Lipmann, *Nature*, 138: 1,097, 1936.

[6] E. S. G. Barron and C. M. Lyman. To be published.

[7] W. Langenbeck, *Ergeb. Enzymforsch.*, 2: 314, 1933.

[8] K. G. Stern and J. L. Melnick, *Jour. Biol. Chem.*, 131: 597, 1939.

To test the validity of this hypothesis, experiments were performed with white rats fed with a vitamin B_1 deficient diet. The degree of deficiency was followed by the loss of weight and by the determination of blood pyruvate. Rats fed with the same diet plus added vitamin B_1 were used as controls.

The mechanism of the synthesis of carbohydrates from pyruvate by liver slices, a synthesis discovered by Benoy and Elliott,[9] was first studied. If such a synthesis starts with the formation of phosphopyruvic acid from pyruvate and fumarate, aerobically:

$$\text{Pyruvate} + \text{fumarate} + H_3PO_4 + {}_3O_2 \rightarrow \text{Phosphopyruvate} + 4\ CO_2 + 2\ H_2O,$$

Phosphorylated vitamin may accelerate the synthesis of carbohydrate by activating the pyruvate in this primary reaction. Kidney slices of normal rats synthesized 9.93 mgs of carbohydrate per gram of fresh tissue in the presence of pyruvate (372 per cent. increase over the control) and 11.6 mgs in the presence of pyruvate plus fumarate (452 per cent. increase); the addition of vitamin B_1 did not increase these figures. Kidney slices of avitaminotic rats, on the other hand, synthesized only 5.35 mgs of carbohydrate with pyruvate (a 46 per cent. decrease compared to the control) and 5.15 mgs with pyruvate plus fumarate (55 per cent. decrease); on addition of vitamin B_1 there was a synthesis of 11.86 mgs of carbohydrate. In other words, vitamin B_1 restored to normal the rate of carbohydrate synthesis by the kidney slices of avitaminotic rats (Table I).

TABLE I

SYNTHESIS OF CARBOHYDRATE BY RAT KIDNEY SLICES*

Added substrate	Mgs glucose per gm fresh tissue	
	Normal	Avitaminotic
No substrate	2.10	2.54
Pyruvate (Pyr.)	9.93	5.35
Pyr. + fumarate	11.20	5.15
Pyr. + fum. + B_1	11.20	11.86

* Incubated for 3 hours at 38° in $NaHCO_3$-Ringer buffer with O_2 : CO_2 as gas phase; pH, 7.4. The values given are average values of several experiments. Pyruvate, 0.08 m.M.; fumarate, 0.04 mM; vitamin B_1, 50γ or 50 micrograms.

The next reaction studied was the formation of citric acid by pyruvate and oxaloacetic acid, a reaction discovered by Knoop and Martius:[10]

$$\text{Pyruvate} + \text{Oxaloacetate} + \tfrac{1}{2}\,O_2 \rightarrow \text{citrate} + CO_2.$$

Phosphorylated vitamin B_1 may accelerate the synthesis of citric acid by activating the pyruvate which takes part in this reaction. *Chopped heart of control* rats produced 3.32 mgs of citric acid after 30 minutes' incubation with pyruvate and malate (malate goes readily into oxaloacetate) and 3.39 mgs on addition of vitamin B_1. When fumarate was used instead of malate, there was 20 per cent. less citric acid formed. The synthesis of citric acid by the heart of avitaminotic rats was decreased by 50 per cent. with pyruvate and malate and by 73 per cent. with pyruvate and fumarate as substrates. The lack of increase in the synthesis of citric acid on addition of vitamin B_1 must be attributed to lack of its phosphorylation during the short time of its incubation. In fact, when rat kidney slices of avitaminotic rats were incubated with vitamin B_1 previous to the addition of substrates, there was an increase of 35 per cent. (Table II).

TABLE II

SYNTHESIS OF CITRIC ACID BY CHOPPED HEART AND KIDNEY SLICES OF RATS*

Added substrate	Mgs citric acid per gm fresh tissue	
	Normal	Avitaminotic
Heart—No substrate	None	None
Pyr. + malate	3.32	1.61
Pyr. + malate + B_1 ...	3.39	1.65
Pyr. + fumarate	2.64	0.75
Pyr. + fumarate + B_1 .	2.76	0.67
Kidney—No substrate		None
Pyr. + malate		0.60
Pyr. + malate + B_1 ...		0.81

* Incubated for 30 minutes at 38° in phosphate-Ringer: pH, 7.4; O_2 as gas phase; pyruvate, 0.134 m.M; 1-malate and fumarate 0.186 mM. Total volumes 3 cc.

These *in vitro* experiments show that the synthesis of carbohydrates and of citric acid with pyruvate as one of the substrates is diminished in tissues from avitaminotic rats, and is increased on addition of vitamin B_1. They are offered as evidence for our view that vitamin B_1 is a catalyst not only for the oxidation and decarboxylation of pyruvate but also for many other reactions where pyruvate is one of the reacting substances.

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BIOELECTRIC POTENTIAL AS INDICATOR OF OVULATION IN THE HEN

IN order to discover bioelectric potential differences connected with the physiology of normal reproduction in the mature fowl a D. C. millivoltmeter[1] was applied to laying hens. The possibility of recovering the egg easily, as well as the fact that the fowl has only one functional ovary, made this species particularly suitable for the experiment.

While the experiments are still under way, some preliminary findings can be reported here.

---

[9] M. P. Benoy and K. A. C. Elliott, *Biochem. Jour.*, 31: 1,268, 1937.

[10] F. Knoop and C. Martius, *Zeits. physiol. chem.*, 242: 1, 1936.

[1] Modification by Dr. R. Parmenter of Burr, Nims, Lane apparatus.

Using silver silver-chloride electrodes in saline solution as a medium of contact, two laying hens were tested in their potential difference between the two sides of the abdomen. Table I gives the results of the test.

TABLE I

Bioelectric Potential Difference in 2 Laying Hens at Different Stages of Reproduction

Hen	Date	Hour	Last egg	MV	Next egg
S	June 6	1 : 15 P.M.	1 : 00 P.M.	− 3.8	
		1 : 25 "		− 26.6	June 7 noon
		1 : 35 "		− 19.0	
	June 7	2 : 00 "	12 noon	− 11.8	
	" 8	10 : 10 A.M.		− 19.8	
		11 : 00 "	10 : 40 A.M.	− 18.4	
		11 : 10 "		− 9.2	
		11 : 20 "		+ 41.0	June 9 noon
		11 : 22 "		+ 9.2	
		2 : 26 P.M.		− 2.6	
	June 10	3 : 00 "		− 1.6	
	" 14	2 : 30 "		− 2.1	
L	June 6	1 : 10 P.M.	12 : 20 P.M.	− 6.3	
		1 : 20 "		− 6.3	
		1 : 30 "		− 51.0	
	June 7	1 : 40 "		− 10.5	
		1 : 55 "		− 10.5	
	June 8	10 : 30 A.M.	8 : 00 A.M.	− 10.5	
	" 10	2 : 50 P.M.	2 : 20 P.M.	− 54.2	June 11 1 : 00 P.M.
		2 : 55 "		− 50.4	
	June 14	3 : 00 "		+ 4.2	no egg
	" 17	2 : 30 "		− 4.2	" "

The non-ovulatory potential corresponded closely to the potentials of other species (pig, man, goat and dog) and there was a violent rise in potential difference at the time when ovulation must have occurred according to Warren and Scott (1934).[3] Tests were made frequently from the moment when an egg was laid to several hours afterward, and the peak in potential was found forty minutes in one case, twenty-five minutes in another case, and thirty minutes in the third case after oviposition. In both cases the ovum was recovered, that is, both hens laid eggs about 24 hours following their high potential. Two hours after ovulation it had reached normal, non-ovulatory levels.

While these results have to be repeated on a larger scale, it is hoped that some clue will be found as to the direction of the potential in connection with the one-sided ovarian function in the hen. So far, most readings have had negative values, but not all of them.

M. Altmann

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THERMOSTATIC CONTROL

The few essential parts required are shown in the accompanying circuit diagram. It will be noticed that no batteries are needed, since the device is completely A.C. operated.

A dual triode tube of the 6A6 type (or equivalent) is employed with the plates and grids connected in parallel. In this circuit the tube acts as a half-wave grid-controlled rectifier. By the use of a bleeder resistor across the A.C. plate supply voltage the grid return through the thermoregulator circuit, TR, may be adjusted to such a value that the grid voltage becomes of sufficient magnitude in phase with the plate voltage to operate the relay, due to the rectified cathode current. The condenser stores sufficient energy and produces enough lag to keep the relay from chattering.

Any sensitive relay that will operate on 15 ma. or less and having from 2,000 to 5,000 ohms may be used. The circuit requires but one preliminary adjustment. Short the input (TR) leads and, starting from point A, move tap P along the bleeder resistance toward B until enough current flows through the relay coil to make it close. To insure reliability it is well to move P a little beyond this point. An alternative method is to merely insert a milliammeter in the plate lead at X and adjust P until the current reads that value specified for the type of relay used.

A "Sigma" type M relay of 2,000 ohms was used in one model of this device. It has been operating a

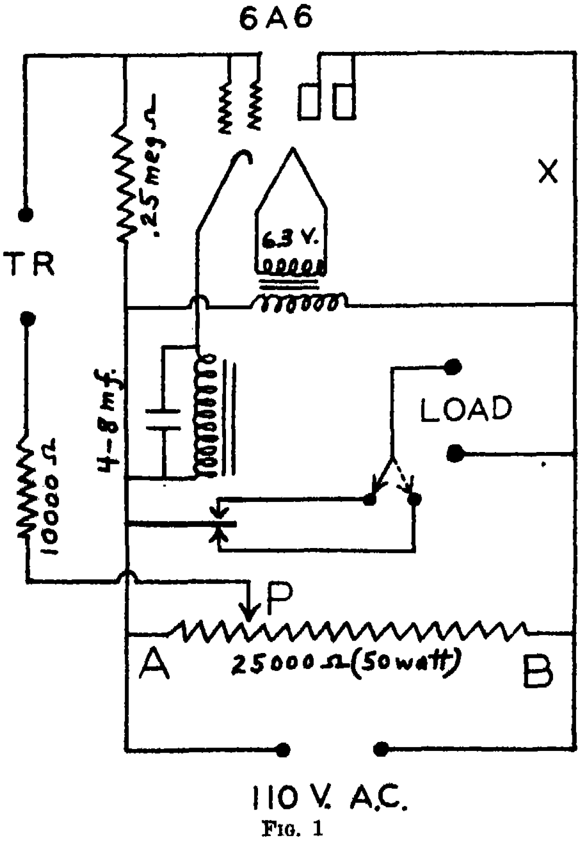

Fig. 1

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[3] D. C. Warren and H. M. Scott, Science, 80: 461–462, 1934.

heating unit in an incubator for over 50 days continuously or more than 1,200 hours without any failure or servicing. This relay is capable of handling up to 500 watts. However, from past experience the writer prefers the use of a mercury type relay switch for control of powers exceeding 300 watts in order to eliminate contact difficulties.

Another model of this device made use of an "Allied" type relay (2,500 ohms). There are many other equally suitable makes available. The control tube operates such relays, whose single pole double throw contacts then operate a power control relay of the mercury tube type.

With either of the two arrangements mentioned the contact combination of the relays allows for either on or off control. The circuit will respond even with poor contact at the input. Grasping one input connection in each hand allows sufficient conductivity to operate the relays.

The complete parts, including the small high resistance control relay, can be secured at a cost of about four dollars. Needless to say the mercury or power control type of relay entails additional expense and determines the successful operation of the device where considerable power is involved.

The choice of thermoregulator to be used with this device is dictated by the sensitivity of control desired.

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USE OF SODIUM THIOGLYCOLLATE IN CULTURING LARGE VOLUMES OF ANAEROBIC BACTERIA

IN many of the present problems concerning the anaerobic bacteria it is desirable to grow large quantities of various strains or species. Examples of these include the production: of cells for antigenic analysis; of toxins of the tetanus or gangrene organisms, particularly when toxoid is to be prepared for active immunization; and of cultures for studies of sugar fermentation mechanisms or other physiological properties. Except for the latter problems, often the medium employed is a complex meat infusion with particles of meat, and precautions are taken to inoculate the medium immediately following sterilization, and other procedures, amounting almost to a ritual, are followed. Since some of the most important disease-producing anaerobes are among the group requiring strict anaerobic conditions for growth any simplification of the technique of culturing these organisms is welcome. In this regard the recent announcement by Brewer[1] of the use of sodium thioglycollate as a reducing agent to be used in fluid media, without vaseline or other protective seals, in the cultivation of anaerobic bacteria is of considerable interest. This compound, a stable salt of thioglycollic acid which may be added to a medium prior to autoclaving, appears to possess advantages over other chemical agents which have been proposed.

We have been interested in the production of cells for antigenic analysis of *Clostridium oedematiens,* which is one of the more strictly anaerobic species in contrast to *Cl. welchii.* The medium used consisted of beef heart infusion broth[2] plus 0.5 per cent. glucose. This medium is autoclaved in 125 cc amounts in 6 oz. oval prescription bottles closed by screw caps. These are inoculated with 2.0 cc of an active meat culture. Successful transplants are possible (and failures with this group are not infrequent) only if the medium is inoculated immediately following autoclaving. With the addition of 0.1 per cent. sodium thioglycollate[3] and 0.01 to 0.05 per cent. agar to this medium we have experienced no failures in several hundred transplants. Further advantage is gained by the fact that the necessity for the immediate inoculation is avoided and the medium, maintaining a reduced state, is satisfactory for those strains which have a prolonged lag phase.

Although our experience has been less extensive with these we have found the thioglycollate of value in culturing strains of *Cl. welchii, Cl. septicum, Cl. oedematoides, Cl. tetani* and *Cl. parabotulinum.* These preliminary results confirm the claims made by Brewer[1] that sodium thioglycollate may have considerable value as a reducing agent, and it is recommended for trial to those engaged in problems which necessitate the culturing of large volumes of anaerobic bacteria. Further studies on specific uses of sodium thioglycollate are in progress and will be reported in later communications together with a consideration of the dehydrated medium also proposed by Brewer.

L. S. MCCLUNG[4]

THE HARVARD MEDICAL SCHOOL

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[1] J. H. Brewer, *Jour. Bact.,* 39: 10, 1940.

[2] L. S. McClung, *Jour. Bact.,* in press.

[3] Supplied by the Baltimore Biological Laboratories, Baltimore, Maryland.

[4] *Fellow of the John Simon Guggenheim Memorial Foundation.*

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IRA REMSEN AND AMERICAN CHEMICAL RESEARCH LITERATURE[1]

By Dr. FREDERICK H. GETMAN

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WITH the return of peaceful conditions following America's wars with England, the energies of the people were soon directed intensively toward the development of the natural resources of the country and to the extension of its western frontier. An awakened sense of nationality and destiny, as well as a sense of the immensity of the task of material exploitation, had begun to influence all classes.

As a recent historian has pointed out:

> Over the mountains the great valley two thousand miles wide, with its unified river systems four thousand miles long, opened an empire such as man had never seen.

This intensive concentration of the nation's efforts toward the discovery of our natural resources and to the development of economic methods for their utilization in the arts naturally led to the creation of an urgent demand for trustworthy sources of information concerning the latest discoveries in both pure and applied science.

It was to meet this growing need that Benjamin Silliman, professor of chemistry and natural history at Yale College, founded the *American Journal of Science and Arts* in 1819.

This journal may justly be regarded as the forerunner of all American scientific periodicals. In the first number of the journal, Silliman outlined the scope of his projected periodical in these historically significant words:

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[1] Read at the luncheon of the alumni of the Johns Hopkins University in attendance at the meeting of the American Chemical Society in Cincinnati, Ohio, April 8–13, 1940.

> This journal is intended to embrace the circle of the Physical Sciences, with their application to the Arts, and to every useful purpose. It is designed as a deposit for *original American Communications;* it will contain also occasional selections from Foreign Journals, and notices of the progress of Science in other countries. Within its plan are embraced *Natural History,* in its three great departments of *Mineralogy, Botany* and *Zoology*—as well as *Chemistry* and *Natural Philosophy* and their various branches along with *Mathematics,* pure and mixed. It will be a leading object to illustrate *American Natural History,* and especially our *Mineralogy* and *Geology. The Applications* of these sciences are obviously as numerous as *physical arts,* and *physical wants;* for no one of these arts or wants can be named which is not connected with them. While science will be cherished *for its own sake* and with due respect for its own *inherent dignity,* it will be employed as the *handmaid to the arts.* Its numerous applications to *Agriculture,* the earliest and most important of them; to *Manufactures,* both mechanical and chemical; and to *Domestic Economy,* will be carefully sought out and faithfully made.

With this ambitious program, Silliman's journal made its appearance as America's first scientific periodical and, for one hundred and twenty years, it has continued to maintain its position as the dean of America's scientific journals. The pages of the early numbers of this journal afford a bird's-eye view of the state of scientific learning in the United States during its formative period, while the names of many of its scientific pioneers, along with an account of their experiments, furnish a wealth of interesting reading for the scientific historian.

Upon the death of Benjamin Silliman in 1853, his journal was carried on under the editorial supervision of his son, Benjamin Silliman, Jr., with the cooperation of James and Samuel Dana as co-editors.

The rapid growth of the country, together with the corresponding development of science, both pure and applied, ultimately compelled the editors to confine the scope of Silliman's journal to articles dealing solely with pure science. With this restriction of scope, the title of the publication was changed to the *American Journal of Science.* This change of policy may be regarded as marking the beginning of the process of journalistic segregation which has since that time proceeded at an ever accelerating pace.

Prior to 1879, several sporadic attempts had been made to establish a journal devoted exclusively to chemistry. Thus, in 1813, a single volume of scientific memoirs was issued by the Columbian Chemical Society, while from 1870–1877, a periodical known as the *American Chemist* was edited by Charles F. and William H. Chandler. This may properly be regarded as the first chemical periodical in America.

Although the American Chemical Society had already been organized in 1876, the first number of its journal did not appear until three years later, while it was not until 1893 that regular monthly numbers were issued.

Edward Hart had, in 1887, established the *Journal of Analytical Chemistry;* the title of this periodical was changed four years later to the *Journal of Analytical and Applied Chemistry.* This journal was subsequently merged with the *Journal of the American Chemical Society* in 1893, at which time its editorial supervision was entrusted to Dr. Hart.

Shortly after delimiting the scope of the *American Journal of Science,* its editorial staff took a further step which was destined to mark the beginning of a new era in American chemical publication.

The Johns Hopkins University had only recently opened its doors, and its chemistry department, under the direction of Ira Remsen, soon became a veritable Mecca for graduate students of chemical science. Shortly after assuming the chair of chemistry at Williams College, prior to coming to Baltimore, Remsen had begun to send papers embodying the results of his experimental researches to the *American Journal of Science.* After coming to Baltimore his chemical contributions to this journal steadily increased until, in 1879, the editor, James D. Dana, becoming alarmed at their number, was obliged to decline any further material from the Johns Hopkins laboratory. Referring to this incident in later years Remsen wrote:

> In a short time my manuscript was returned with the statement that it would be necessary to find some other place to publish my articles, as they seemed too highly specialized for a journal of general science. Professor Dana very kindly suggested that I start a journal myself. After corresponding with the leading workers in chemistry with discouraging as well as encouraging results, I decided to act upon the suggestion, and early in 1879 the first number of the *American Chemical Journal* was issued.

Thus, it came about that after sixty years as America's leading scientific periodical, the *American Journal of Science* found it impossible any longer to afford unrestricted space for the constantly increasing number of chemical papers submitted for publication. History was again repeating itself; for just as in 1819, following the country's struggle for independence, the *American Journal of Science* had come into existence to meet the need for a source of information in the field of general science, so in 1879, following the dark days of civil conflict, Remsen established the *American Chemical Journal* as a medium of publication for the rapidly multiplying papers resulting from the awakening of American institutions of learning to the importance of chemical research.

The task of launching a journal of this nature was an undertaking calling for both courage and wisdom. In assuming this task Remsen was undoubtedly inspired by the memories of his idol and one-time teacher, Liebig, of whom he later wrote:

> It was my good fortune to come under the influence of Liebig in my early years as a student of chemistry. For a full academic year I had the privilege of sitting at his feet and hearing him expound the elements of chemistry. I also came to know him, as a youth may know a master, and this association has been the chief inspiration of my life. Liebig impressed me so strongly that I have been led to study his life more carefully than I have ever studied any other life. And the more I have studied it the more strongly I have been impressed.

During his student days in Germany, Remsen had read through the entire *Annalen der Chemie* and thus quite unconsciously there had been imprinted on his mind a pattern of scientific journalism worthy of subsequent emulation. In fact, in the establishment of the *American Chemical Journal* we may well believe that Remsen treasured the secret hope that his journal might ultimately become the *American Annalen*.

Inspired by such an ambition and qualified by experience, both in teaching and research, Remsen's success as an editor was practically assured. Any doubts which he may have felt in this new undertaking were soon dispelled by the enthusiastic reception the journal received from members of the chemical profession both at home and abroad. In referring to the early days of the journal, Remsen wrote:

> The editor of the new journal was entirely inexperienced in the work that devolved upon him, and he owes much to the wise counsel and friendly co-operation of Professor Dana. At first, six numbers a year were published and there were many times when there was difficulty in filling these. By 1889 the supply of material had increased to such an extent as to lead to an enlargement. After this for seven years, eight numbers a year were issued. Beginning in 1896, ten numbers a year were issued; and, finally, in 1899, the Journal became a monthly publication, and even then it was found difficult at times to take care of all the material that was sent in.

That he was gratified by the success of his journalistic venture is reflected in a letter sent to his wife soon after the appearance of the first number of the periodical. He wrote:

> Yesterday I worked all day on matters connected with the Journal. I enjoy the work as proof is coming in every day, and it is really delightful to see the thing growing from day to day. I take a genuine pride in it.

Professor Remsen never relinquished the editorial supervision of his journal, despite ever-increasing official duties. Even when, as president of the Johns Hopkins University, the employment of an assistant-editor became necessary, he never wholly delegated his editorial duties to other hands. The meticulous attention given by him to his editorial duties have been entertainingly recalled by one of the assistant editors during this period. From these recollections we are privileged to catch a glimpse of that fabled retreat, "the editorial sanctum," of which the poet has written:

> Who would not be an editor.—To write
> The magic 'we' of such enormous might;
> To be so great beyond the common span
> It takes the plural to express the man;

While from these recollections we learn that the force of the editorial "we" was frequently invoked, at the same time we find that throughout the administration of his office as editor he was never unreasonable or dictatorial. He was insistent upon extreme care and promptness in correcting proof and was wont to become quite impatient with authors who would not promptly read and return their galley proofs. He often said that one great trouble with young chemists with their first papers in type was that they wanted to show the proof to all their friends without regard to the necessity of returning it to the editor without delay. Before being sent to the printer all copy was reread and carefully corrected, while particular attention was given to the observance of certain editorial conventions such as the proper use of the suffixes "in" and "ine." Instinctively an adept in the use of unambiguous, incisive English, Remsen's natural ability as a writer had been so whetted by experience as an author and lecturer that, when he assumed the role of editor, he had become a veritable master in the use of his native tongue.

It is not surprising, therefore, to find him debating with one of the professors in the department of English at Johns Hopkins as to whether one should write "20 grams *was*," or "20 grams *were* taken." He was also very particular as to correct orthography and on one occasion remarked: "A man is not a chemist until he learns how to spell guaiacol!"

It should be pointed out that he by no means accepted everything that was submitted to him for publication. Even at the risk of incurring the resentment of some of his would-be contributors, he consistently refused material which might tend to lower the high standard he had established for his journal. It should be repeated, however, that notwithstanding Remsen's insistence that authors must strictly conform to certain fundamental editorial rules and conventions which he had established, he was never unreasonable or inconsiderate in his editorial requirements. In fact, one who assisted him in his editorial labors has said of him, "Dr. Remsen, if anything, leaned backward in his efforts to be fair and absolutely impartial."

Thus it came about that the *American Chemical Journal* was soon regarded, both in this country and abroad, as one of the important chemical publications of its time. It has been justly appraised by Professor W. A. Noyes as "The first really scientific journal of research chemistry in America."

One needs only to scan its pages to find among its contributors those whose names constitute the honor-roll of American chemistry during the last quarter of the nineteenth century.

In 1915, upon the completion of the fiftieth volume, the *American Chemical Journal* was merged with the *Journal of the American Chemical Society*. This action was taken with Remsen's unqualified approval.

In referring to this eventful step, the retiring editor said:

> For a number of years the *American Chemical Journal* contained the principal original contributions that came from this country. It flourished beyond my expectations, but within the last few years it became evident to me that the journal of our society was coming more and more to be looked upon by American chemists as the best medium of publication of their contributions and, somewhat reluctantly and with a sacrifice of sentiment, I transferred my Journal to the tender mercies of the Society in full confidence that the interests of American chemists would, on the whole, be better served by consolidation than by separate existences.

And then he added with characteristic modesty:

> I think it probable that the *American Chemical Journal*, especially during the early years of its existence, exerted a stimulating influence upon chemical research in America, but no one can measure the influence, and it is perhaps idle to refer to it as a possible factor.

After having served for nearly a decade as editor of the *Journal of the American Chemical Society*, Dr. Hart was succeeded by Dr. William A. Noyes. It should be noted that both of these men had pursued graduate work at the Johns Hopkins University under Remsen. The former, who enjoyed the distinction of having been one of the first to receive one of the coveted graduate fellowships in chemistry at Baltimore, received his degree in 1879, while Dr. Noyes earned his doctorate three years later.

When the *American Chemical Journal* was incorporated with the *Journal of the American Chemical Society* we may well believe that Remsen felt no uncertainties as to the future welfare of his child on surrendering its editorial management to his former pupil, Dr. William A. Noyes.

In 1917, after fifteen years of distinguished service as editor of the journal of the society Dr. Noyes was succeeded by Dr. A. B. Lamb, the present editor. By this act the editorial mantle of Remsen and two of his pupils, Hart and Noyes, was transferred to the shoulders of a son of Harvard. It is scarcely necessary to point out that the traditions of former years are being cherished as a worthy heritage and despite the fact that "New conditions teach new duties," and although "Time makes ancient good uncouth," even so our journal continues to reflect the lofty aims of its founders.

With the dawn of the twentieth century the need for an American *Centralblat* had become apparent and, ultimately, in response to the desire of many of its members, the society inaugurated in 1907 the publication of *Chemical Abstracts*. Here again the editorial supervision of this new periodical was entrusted to two "Hopkins" chemists; initially to Dr. Noyes and subsequently to Dr. A. M. Patterson.

The day in American history was fast passing when a chemist could enjoy the distinction of knowing something about everything in his science and in place of this more or less unwarranted reputation came the urgent demand for a man knowing everything about some one thing in chemistry. Quite relentlessly the era of intensive specialization superseded that exceedingly comfortable period when a first-class chemist's knowledge of his subject was limited by practically no horizons. Journals devoted to highly specialized domains sprang into existence with bewildering rapidity until to-day no less than forty strictly scientific journals are to be found in our current American chemical literature. Among these the *Journal of Chemical Education* and the *Journal of Rheology* claim our attention because of the association of the names of two other "Hopkins" chemists with their editorial management. The first editor of the former was Dr. Niels Gordon, while the editor of the latter, since its inception, has been Dr. Eugene C. Bingham. Both of these gentlemen, it should be noted, trace their chemical ancestry back to Ira Remsen.

In addition to this imposing list of journals we must not omit to mention the valuable scientific and technological monographs sponsored by our society which have been appearing at frequent intervals since 1920 under the editorship of W. A. Noyes, John Johnston and Harrison E. Howe.

And to-day, when many a chemist is finding it well-nigh impossible "to keep abreast of (chemical) truth" and when, moreover, a slender income precludes the possibility of extensive subscription to chemical journals, another Remsen disciple, Dr. Atherton Seidell, brings forward the bibliofilm as a means of solving the difficulty. The future of this *multum in parvo* library can scarcely be foreseen, but it has already proven to be of inestimable value to research chemists residing in isolated sections of the country.

In this brief review of the history of chemical journalism in America one fact of especial interest to all Hopkins chemists stands out and that is that the imposing array of our chemical periodicals, and especially those sponsored by the American Chemical Society, may quite justly be regarded as "the lengthened shadow of one man"—Ira Remsen.

THE PUBLICATION OF SCIENTIFIC RESEARCH

By Dr. ATHERTON SEIDELL
U. S. PUBLIC HEALTH SERVICE

THE periodicals devoted to the publication of scientific research are of the most varied character. They may contain relatively few original papers or be devoted exclusively to such reports. They may appear at very irregular intervals or sufficiently frequently to make several volumes per year. They are published in many countries and under widely varying conditions.

The majority are issued at the expense of academies, governmental agencies, scientific societies or other organizations having for their object the promotion of one or several branches of science. Some are house organs of industrial establishments. A certain number are published by private initiative on a more or less self-supporting basis. In general, however, purely scientific periodicals require some form of subvention. Those sponsored by scientific societies are usually supported by dues received from members.

They are in all cases collections of reports upon many different problems in one or several fields of science. For this reason any one journal contains papers upon a far greater variety of subjects than are of direct interest to an individual or small group of research workers. To obtain the papers concerned with a given problem, a far larger number of reports of no immediate application to that problem will be simultaneously received. These increase the cost of those desired both for their acquisition and subsequent conservation.

Due to the varied character of scientific periodicals the published reports upon given problems are scattered in a larger number of journals than can usually be afforded by individual workers. Such persons must therefore depend upon the collections of the larger institutions for their literature requirements. For this reason scientific research can usually be advantageously pursued only in proximity to adequate library collections.

The present system of publishing original scientific research thus restricts its acquisition to the community of workers. This is in striking contrast to that other important class of scientific literature composed of digests, treatises, reviews, text-books, etc., which is largely distributed to individual students and specialists. The market for the one is accordingly restricted and that for the other of far greater diversity.

In addition to this difference in market there is also a difference in the literary character of the two classes of publication. The one consists almost exclusively of concise and very accurate descriptions of natural phenomena or of experimental investigations, contributed by numerous individuals. The other, represented by monographs, compendia, text-books, etc., consists of the orderly presentation and critical discussion of the facts disclosed in the original communications published in the journals. They are usually written by one or a small group of authors and depend for their success upon the manner of treatment of the subject and the clarity and excellence of the presentation. They are essentially the type of literary production for which the author is entitled to the protection afforded by copyright. This can not be claimed with equal justice for the original communications published in the scientific periodicals. These are essentially contributions to the advancement of science, offered in return for reciprocal benefits derived from the similar contributions of others. Any restriction upon their most widespread use, which might be imposed by copyright, is not only contrary to the wishes and best interests of research workers but also indirectly to the public welfare.

There is furthermore an essential difference in the risk involved in the publication of these two classes of scientific literature. In the case of periodicals their sale is largely provided for in advance by subscriptions and, after each issue is distributed, very little if any further returns can be realized from reserve stocks. Copyright protection is accordingly of negligible value. In the case of compilations, treatises, text-books, etc., the risk must be wholly assumed in advance by the author and publisher. The entire profits are derived from the sale after publication, hence copyright protection is indispensable to assuring a just reward of the efforts which the undertaking has involved.

In recent years a procedure for the greater diffusion of reports of original scientific investigation than can be secured by journal publication alone, has been developed. This consists in the photographic reproduction upon microfilm of the separate articles in the periodicals and the distribution of these to workers who do not have access to the journals in which the reports are published.

The process is the most economical so far devised for making a single copy of a given text. By means of it the scattered articles upon a given research problem can be segregated from the numerous others with which they are published in journals. The research worker is enabled at small cost and without effort to collect the papers pertaining to the problem upon which he is engaged. It has rendered proximity to adequate literature collections no longer an indispensable requisite to the prosecution of experimental research.

Microfilm copies offer a number of advantages over the printed texts as contained in the bound journals. Among these is their insignificant bulk, which permits the assembling of a far larger number of papers at one time than can be brought together in the bound volumes of journals each containing only one or a very few papers on a given subject.

Furthermore, the collected microfilm copies of papers can be kept and need not be returned promptly to the library for the use of others, as is the case with the bound periodicals. The microfilm copies when attached to cards or sheets of papers lend themselves to filing for future reference exactly as manually prepared notes, reprints or any other collected material upon a given subject. They are especially adapted to the assembling in the most convenient form of the large numbers of scattered publications required by authors of compendia, treatises, textbooks and all other digests of scientific literature.

Microfilms, however, have the disadvanatge that they differ in form from the ordinary printed page with which from long habit one has become accustomed, and in addition require special means for reading them. The devices which are available for this are monocular magnifiers and projection apparatus. The former, although quite inexpensive, require a certain effort for use, and the latter have not yet been produced at a price within the means of most individuals. Since, however, microfilm copies usually represent only a small fraction of the literature collections made by individuals, the effort to read them will not be a serious task, and will be very largely repaid by the advantage of having at hand the photographic copy of the original publication.

In connection with microfilm copying from scientific periodicals, only one criticism has so far been advanced. This is in reference to the possible effect the increasing use of microfilms may have upon subscriptions to journals. It is apparent, however, that such an apprehension is ill-founded when the total amount of published original research is considered in relation to the inconsiderable fraction of it that may be desired and can be copied in the form of microfilms. If, for example, the field of medical research is considered, the total number of titles of books and journal articles listed during the last 60 years by the Index Catalogue of the Army Medical Library is about 2,500,000. If it is assumed that one half of these have become obsolete, a request for a single copy of each of the remaining 1,250,000 would require more than 100 times the microfilming equipment and number of persons employed in the several services now operating. Even if microfilm services should attain 100 times their present capacity only a single complete copy of any one journal would, on the average, be distributed as microfilms in one year. This corresponds to fewer copies than are given away by authors in the form of reprints supplied by the publishers. It is evident, therefore, that microfilm copying can not justly be charged with adversely influencing subscriptions to scientific journals.

The real cause of the failure of certain scientific periodicals to attract and retain a sufficient number of subscribers to pay the cost of their publication is the diversity of their contents. There is probably a close relationship between the financial stability of a journal and its degree of specialization. Those journals serving a particular field of research become indispensable to the workers in that field and will be supported by individuals, whereas those containing papers upon many branches of science can be afforded only by large institutions in which research in many fields is being pursued.

Periodicals of this latter type have in many cases been founded without due regard to the purposes to be served. They sometimes simply satisfy the aspirations of those responsible for their existence or may be used largely as exchanges for securing other periodicals. They frequently become the cemeteries in which useful descriptions of original research are buried. They greatly increase the difficulties of bibliographic searches and contribute to the chaos in publication which now prevails. It is evident that a complete reorganization of the present system of publishing the results of scientific investigation is needed.

Toward this end an advisory council on publication should be organized in each country for the purpose of studying the existing periodicals and defining more precisely the character of the contributions to be published in each. A system of routing the original communications in accordance with the field covered by each journal should also be established. The more highly specialized periodicals produced in this manner would enable the subscribers to receive more papers in which they are interested and fewer on subjcts with which they are not concernod. The individual research worker would find it to his advantage to subscribe to them, and the cost of their publication would thus be distributed to an increasing extent among those for whose special benefit they are produced.

The supervision of publication by a central agency in each country would probably result in the elimination of some journals and avoidance of the many changes in character, policy, title, size, price, etc., in others which now so greatly complicates the collection and maintenance of complete sets of periodicals by libraries and the task of making bibliographic searches in them.

Although abstract journals aid in reducing the disadvantages of the haphazard publication of scientific research by classifying and indexing the papers contained in the journals, they constitute a partial republication of the original contributions and to this extent are uneconomical. A part of the cost of publishing abstracts could probably be saved if the contents of the journals themselves were sufficiently uniform to permit workers to obtain directly a larger proportion of the original papers in which they are interested.

It is also probable that if abstract journals themselves were restricted to narrower fields, those using them would be better served at a lower cost. If, for example, *Chemical Abstracts,* which now attempts to cover the entire field of chemistry, were issued in several parts, chemists would be relieved of the obligation of purchasing and conserving the abstract literature of those branches of chemistry in which they are not directly engaged. It is apparent that the urgent need in the publication of scientific research is a greater degree of specialization in both the periodicals and the abstract journals.

In addition to the problem of better organization of scientific publication there is also the question of securing the funds for printing the rapidly increasing number of papers which are being written. Practically all journals are forced to either refuse many papers or publish them in such condensed form that their usefulness is greatly impaired. A plan for relieving this situation, based upon the use of microfilms, has recently been proposed by Watson Davis, director of Science Service. This plan has been designated "Auxiliary Publication" and provides that papers which editors are unable to accept in their complete form be condensed for printed publication and, in connection with such résumés, notice given that the complete paper with all the charts, tables and explanatory details has been deposited with a central agency which distributes microfilm copies of it at a modest stated price. Thus for purposes of bibliographic classification the paper is widely circulated in curtailed printed form and for the benefit of those directly interested in the details of the work it is distributed as photographic microfilm copies. The organization of Auxiliary Publication is a task which advisory councils on scientific publication in each country should undertake in connection with the supervision of publication in general.

A common reproach to scientific investigation is that adequate use is not made of so much of it that is published. The cause of this is simply the inaccessibility of such a large proportion of it to those capable of using it to advance science. Aside from the introduction of microfilm copying no improvement in the means of distribution of original description of scientific research has been made in recent years. The perfection and extension of microfilm copying as well as the reorganization of the printed publication of scientific research is deserving of the earnest support of all who are interested in the advancement of science and the public welfare.

SCIENTIFIC EVENTS

RESERVATION BY THE U. S. FOREST SERVICE OF A VIRGIN HEMLOCK-BEECH FOREST

THE U. S. Forest Service has announced the formal setting aside of 4,131 acres of essentially virgin hemlock-beech forest, on the Allegheny National Forest in northwestern Pennsylvania, to be devoted permanently to scientific use and for the education and enjoyment of the public. This area is seven miles south of Ludlow, and is unique in that it contains the largest acreage of original forest of its type in the east. It is also the largest single remaining body of virgin timber between the Adirondacks of New York State and the Great Smokies of North Carolina. The purchase and reservation of this tract, which was advocated by leading scientific men and promoted by the Pennsylvania Forestry Association, had the support of the late Chief Forester F. A. Silcox, and was approved by the National Forest Reservation Commission in 1934. Its reservation is an important forward step in the U. S. Forest Service program of permanently preserving natural areas characteristic of native forest and range vegetation in all regions of the United States.

In administering this area the Forest Service recognizes two obligations. First, to preserve the native plant and animal life in its natural state in so far as this can be done on an area of this size, and, second, to allow the public to enjoy its unique qualities without jeopardizing their perpetuation. For this reason the area is divided into two parts; the northern portion, consisting of 2,018 acres and designated as the Tionesta Scenic Area, will be made accessible to the public by road and foot trails. Here the inspiration and true recreation to be found in a fairly large area of primeval forest may be enjoyed amid towering hemlock 300 to 500 years old and veteran beech 350 years of age. The southern portion, consisting of

2,113 acres and designated as the Tionesta Natural Area, is dedicated primarily to scientific research.

The report points out:

> This area is admirably suited for studying the response of the forest to climatic and biologic cycles, the development of the climax type, and the natural rejuvenation that results in the perpetuation of the climax. It is equally valuable for studying how completely the virgin forest supplies the life needs of the various animals found therein, and of how the forest with its multitude of different plant and animal forms influences the local climate, the soil and the regimen of streams. This natural area is in effect a primeval laboratory and as such it is open to all interested scientists for use. It is the desire of the Forest Service that full use be made of this tract as a center for research in forest and animal ecology.

Those who are interested may secure further information concerning the possibilities for research in this tract from the Allegheny Forest Experiment Station, Philadelphia.

EXPLORATION ON THE WEST AFRICAN COAST

George H. Tate, assistant curator of mammals of the American Museum of Natural History, has returned to New York after spending eighteen months in exploration and collecting in the rain forests of the West Coast of Africa.

In spite of torrential rains, once 14 inches in one day, the effects of the war in African colonies and a hurricane on his journey home, Dr. Tate has succeeded in bringing to the American Museum collections of more than 200 specimens, ranging from lemurs to pangolins. The main purpose of this expedition was to collect chimpanzees and mandrills, as well as foliage and other accessories for two new African Hall habitat groups. Dr. Tate was accompanied on part of the expedition by Robert Kane, artist and preparator of the staff of the museum.

Dr. Tate arrived at Tabou on the French Ivory Coast in April, 1939, and identified the chimpanzee habitat in the western part of the Ivory Coast, near the Liberian border. A collection was made in this region before the winter rains. The French Cameroons were next visited to obtain the mandrill apes that live in the dense tropical forests.

Three days after the arrival of the expedition at the port of Douala, war was declared in Europe, but in spite of the rigid wartime precautions that immediately went into effect, the French authorities allowed Dr. Tate to keep all hunting equipment. Soldiers were stationed at important points and road bridges, and it was necessary to show identification papers every few miles along the road.

Dr. Tate reports:

> In a region ten miles square, about half way between Kribi and Yaoundi, we located the mandrill bands and collected specimens for the Akeley African Hall group. We found that the mandrills traveled in large bands, numbering from 15 to 20 individuals and always led by an old male, larger and of the true mandrill coloring in red- and blue-skinned face. When danger approached, the band would scamper into the upper branches of the trees, while the old "head man" galloped away through the forest on the ground.
>
> Bad news came to us after the completion of this part of the expedition. Due to the rainy season, our collection of chimpanzee skins had arrived at the museum in New York unfit to mount as group specimens. We went back to the Ivory Coast to replace the first collection and found that we could not enter because our visas had expired. In the end, a second collection was obtained by going into Liberia and approaching the chimpanzee country at the Cavally River from the west, with headquarters at the Firestone plantation.

TECHNOCHEMICAL LECTURES AT THE MELLON INSTITUTE—1940–1941

A series of fourteen lectures on the present condition of the American Chemical Industry will be presented by technologic specialists of Mellon Institute of Industrial Research during 1940–41. These discourses will be delivered on alternate Thursdays, in the fourth period (11:30 A.M.–12:30 P.M.), throughout both semesters, in the auditorium of the institute. They will be open to all students of industrial chemistry and chemical engineering in the University of Pittsburgh, as well as to the members of the faculty.

October 3. Dr. E. R. Weidlein, "Trends in the Chemical Industry."
October 17. Dr. F. W. Adams, "Development of the Manufacture of Heavy Chemicals."
October 31. Dr. B. G. Wilkes, "Some Industrial Products of Synthetic Organic Chemistry."
November 14. Dr. H. J. Rose, "Engineering Opportunities in Fuel Technology."
December 5. Dr. W. A. Gruse, "Progress through Research in Petroleum Technology."
January 2. Dr. R. L. Wakeman, "Engineering Opportunities in Plastics Technology."
January 16. Dr. F. L. Jones, "Optical Glass—A Key Industry."
February 20. Dr. H. E. Simpson, "Engineering Opportunities in Building Material Technology."
March 6. R. H. Heilman, "Engineering Importance of Heat-Insulating Materials."
March 20. Dr. G. H. Young, "Corrosion from the Engineering Standpoint."
April 3. Dr. R. C. Johnson, "Utilization of Some Mineral Wastes."
April 24. Dr. P. J. Wilson, Jr., "Progress through Research in Industrial Waste Disposal."
May 8. R. D. Hoak, "Industrial Stream Pollution Problems and Their Solution."

May 22. Dr. H. B. Meller, "The Important Place of Health in the Chemical Industry."

THE PROMOTION OF INTER-AMERICAN CULTURAL RELATIONS

Under the terms of the Convention for the Promotion of Inter-American Cultural Relations the United States has now arranged exchanges of students and professors with nine of the American republics. Ten graduate students from the other American republics have been selected for study in the United States and four additional students will soon be chosen. Eight graduate students and three professors from the United States have been invited to study and teach in other American countries. One of these is Dr. Carroll William Dodge, professor of botany at Washington University, St. Louis, who has been selected by the Government of Guatemala as exchange professor. These arrangements have been made between the United States and the Governments of Chile, Costa Rica, the Dominican Republic, Guatemala, Haiti, Nicaragua, Panama, Paraguay and Venezuela. In addition the United States has been informed that the Governments of Brazil and Peru will undertake similar arrangements in the near future. Plans for these exchanges have been worked out jointly by the Department of State and the Office of Education of the Federal Security Agency. In addition the Governments of Chile, Costa Rica, the Dominican Republic and Peru have indicated their desire to receive a professor from the United States and negotiations are now in process.

The present status of exchanges under the Convention for the Promotion of Inter-American Cultural Relations is therefore as follows:

The Government of *Brazil* has officially notified this government of its intention to inaugurate exchanges in the near future.

The Government of *Chile* has awarded fellowships to two American students and the Government of the United States has awarded fellowships to four Chilean students. Chile is also negotiating for an American professor.

The Government of *Costa Rica* has awarded fellowships to two U. S. students and the Government of the United States will shortly award two fellowships to Costa Rican students. Costa Rica is also negotiating for an American professor.

The Government of the *Dominican Republic* has awarded fellowships to two American students and the Government of the United States has awarded fellowships to two Dominican students. The Dominican Government is also negotiating for an American professor.

The Government of *Guatemala* has selected an American professor.

The Republic of *Haiti* has submitted a panel of students for consideration by the United States.

The Government of *Nicaragua* has selected an American professor and negotiations are in process for the exchange of students.

The Government of *Panama* has awarded a fellowship to an American student and the Government of the United States has awarded fellowships to two Panamanian students.

Fellowships have been awarded by the United States to two students from the Republic of *Paraguay*.

The Government of *Peru* has notified the United States that it will shortly initiate exchange arrangements.

The Government of *Venezuela* has selected an American professor, who is now in Venezuela, and has awarded a fellowship to an American student.

The Buenos Aires Convention was signed by each of twenty-one American Republics at the Inter-American Conference for the Maintenance of Peace held in Buenos Aires in 1936 and has been ratified by thirteen countries. The exchange program is directed toward the development of a more realistic understanding.

The expenses involved in the exchange program are shared by the participating governments. The nominating governments will pay the round trip travel costs of students together with other incidental expenses. The receiving government will pay tuition, subsidiary expenses and board and lodging at the institutions in which the visiting students are enrolled.

GRANTS IN AID OF RESEARCH

The American Association for the Advancement of Science awards grants in aid of research at its annual meeting in December. Since the income from the association's permanent fund has never been great and is declining somewhat with decreasing rates of return from investment, the grants are necessarily small, rarely exceeding $250. Awards are often made to assist in completing investigations already under way or for supplementing funds available from other sources. There are, however, no established limitations on fields or purposes for which grants may be awarded.

Grants in aid of research are awarded upon the recommendation of the committee on grants, which consists of eight members, two elected each year by the council for a term of four years. The members of the committee on grants are chosen from among the various sciences so that every principal field of science is represented.

In order that applications for grants from the association may be examined and passed on by the committee on grants in time to make a report to the council at the meeting in Philadelphia in December, they must be filed in the office of the Permanent Secretary by November 10. After the applications are received they are mimeographed and copies of them are sent to each member of the committee on grants. Application forms and full instructions respecting the information that must be submitted will be furnished by the office of the Permanent Secretary, the Smithsonian Institution Building, Washington, D. C.

RECENT DEATHS

Harry Burr Ferris, since 1933 professor emeritus of anatomy of the School of Medicine of Yale University, died on October 12 at the age of seventy-five years. He had been a member of the faculty of the School of Medicine for forty-one years.

Morris B. Crawford, professor emeritus of physics at Wesleyan University, who until his retirement in 1921 had been a member of the faculty for forty-four years, died on October 9. He was eighty-eight years old.

Dr. Charles Nicoll Bancker Camac, consulting physician of New York City, died on September 20 at the age of seventy-two years. He was from 1910 to 1937 assistant professor of clinical medicine at the College of Physicians and Surgeons, Columbia University.

Dr. Albert Buell Lewis, curator of Melanesian ethnology at the Field Museum, Chicago, died on October 10 at the age of seventy-three years.

Sir Wilfred Thomason Grenfell, founder of the Labrador Medical Mission, died on October 9. He was seventy-five years old. Sir Wilfred was rector of St. Andrews University, Scotland, in 1929.

Sir Robert Abbott Hadfield, London, metallurgist, the inventor of manganese and silicon steel and of other metallurgical improvements, died on September 30 at the age of eighty-one years.

Dr. Henry Stroud, emeritus professor of physics at the University of Durham, died on September 3 at the age of seventy-nine years.

Dr. R. T. Hewlett, emeritus professor of bacteriology at the University of London, died on September 10 at the age of seventy-five years.

Dr. Vito Volterra, formerly professor of mathematics at the University of Rome, died on October 11 at the age of eighty years.

Dr. Julius Wagner-Jauregg, of the University of Vienna, who in 1927 was awarded a Nobel Prize for his work in the use of malaria and other fevers in treating syphilitic paralysis, died on October 1. He was eighty-three years old.

SCIENTIFIC NOTES AND NEWS

Professor George D. Birkhoff, Perkins professor of mathematics at Harvard University, has been elected a foreign associate of the National Academy of Sciences of Lima.

Dr. Walter B. Cannon, George Higginson professor of physiology at the Harvard Medical School, has been appointed Charles M. and Martha Hitchcock professor at the University of California for February, 1941.

Dr. Gustav Egloff, director of research for the Universal Oil Products Company, has been awarded the Octave Chanute medal, given annually for the best paper on mechanical engineering read during the year before the Western Society of Engineers. The paper was entitled "Motor Fuels of the Present and the Future."

The doctorate of laws was conferred at the autumn convocation of Queen's University, Kingston, Ontario, on Dr. J. B. Tyrrell, consulting mining engineer of Toronto, president of the Kirkland Lake Gold Mining Company.

The Experiment Station Record reports that, following service as agricultural adviser to the Government of Haiti, Dr. Atherton Lee, director of the Puerto Rico Federal Station, was tendered the decoration by the President of Haiti as an officer in the Legion of Honor and Merit of that country. Since his work in Haiti, Dr. Lee has served as agricultural adviser to the Governments of Ecuador and Colombia.

Professor Lancelot Hogben, of the University of Aberdeen, author of "Mathematics for the Millions," has become for the present academic year a member of the faculty of the University of Wisconsin. He is giving a course on the history and significance of science, and is conducting a seminar in genetics.

According to *Nature*, Dr. Ivor Jenning has been appointed principal of the University College of Ceylon, and Stanley A. A. Hammond educational adviser on the staff of the West Indian Comptroller.

Dr. H. P. Newsholme has resigned his professorship of public health in the University of Birmingham. Dr. G. A. Auden has been elected acting professor for the duration of the war.

Dr. Richard J. Lund, editor of the *Mining Congress Journal*, has been made assistant group executive in the Mining and Mineral Products Division of the Advisory Commission to the Council of National Defense. He will coordinate work relating to a variety of minerals in the defense program. In this work he is closely associated with Dr. C. K. Leith, consultant on minerals to the commission, and with R. C. Allen, H. K. Masters, H. C. Sykes and E. Vogelsang, specialists on various strategic mineral commodities.

E. W. Engstrom, director of general research of the Radio Corporation of America Manufacturing Company, has been appointed manager of all research activities for the company.

DR. GANO DUNN, president of the J. G. White Engineering Corporation; Dr. David Sarnoff, president of the Radio Corporation of America, and Dr. Harry Woodburn Chase, president of New York University, are included among sixty-two leaders in the commercial, financial, educational, labor and other activities of New York City, who have been appointed by Mayor La Guardia, at the request of Governor Lehman, members of the Local Defense Committee.

DR. CARLYLE W. BENNETT, pathologist in the Division of Sugar Plant Investigations of the Bureau of Plant Industry, who is stationed at Riverside, Calif., sailed for Argentina on September 20 on a scientific mission of six months' duration. Dr. Bennett will investigate virus diseases of sugar beet as they occur in Argentina, giving special attention to the properties of the Argentine curly top known to exist in the Tucuman Province. The investigations will be conducted in collaboration with the Tucuman Experiment Station, and with the Ministry of Agriculture at Buenos Aires. Dr. Bennett expects to return to Riverside in March.

DR. DONALD K. TRESSLER, professor of agricultural chemistry at Cornell University, chief in research and head of the Division of Chemistry of the Agricultural Experiment Station at Geneva, has leave of absence this year in connection with research on the quick freezing of food products. He will visit fruit utilization plants on the Pacific coast, and will study the methods of freezing, canning and dehydrating, and use of by-products.

DURING the past summer Professor A. M. Bateman, a member of the department of geology of Yale University, investigated a deposit of asbestos in Venezuela; Professor R. F. Flint continued his study of glacial features in central Washington, to which he has devoted several earlier seasons; Professor and Mrs. A. Knopf resumed their work on the intrusion and the contact-metamorphic effects of the Boulder batholith, in the vicinity of Helena, Mont.; Dr. G. E. Lewis conducted an expedition to collect vertebrate fossils in parts of Montana, Wyoming, New Mexico and Colorado; Professor C. R. Longwell revisited localities in southern Nevada and western Arizona; George Switzer completed a field study of a problem involving glaucophane schist in the northern Coast Ranges of California. In January, 1941, Professor Longwell will return to Nevada and Arizona for several months of field work, chiefly in the Muddy Mountains and the southern part of the Virgin Mountains. John S. Shelton, instructor in the department last year, during the fall and winter will study and map the northern part of the Virgin Mountains.

DR. W. F. G. SWANN, director of the Bartol Research Foundation of the Franklin Institute at Swarthmore, Pa., gave an address on October 17 before the Washington Academy of Sciences entitled "The Laws of Nature."

DR. C. P. RHOADS, director of the Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York, will address a joint meeting of the Institute of Medicine of Chicago and the Chicago Society of Internal Medicine on Monday evening, October 28, at the Palmer House. His subject will be "Physiological Aspects of Vitamin Deficiency."

PROFESSOR GREGORY PINCUS, of Clark University, gave an address entitled "The Developmental Physiology of Rabbit Eggs" before the Section of Biology of the New York Academy of Sciences on the evening of October 14.

AS the outcome of a conference on the problems of maintaining pure genetic strains of animals and plants needed for laboratory studies in medicine, genetics and related fields the Division of Biology and Agriculture of the National Research Council has set up a committee charged with facilitating the maintenance of needed cultures of various groups of organisms, with the following members: L. T. Webster, *chairman;* M. Demerec, W. Landauer, E. Brand, R. A. Emerson, C. C. Little, Myron Gordon and P. W. Whiting. The committee will welcome information as to the problems of the maintenance of laboratory cultures in the fields which it covers.

AT the installation on October 25 and 26 of Dr. Howard Landis Bevis as seventh president of the Ohio State University, Dr. James Bryant Conant, of Harvard University, will be one of the speakers. The title of his address will be "The University and the Advancement of Learning." In connection with the installation on October 24 there are planned conferences on "The University and Agriculture," with Dean John F. Cunningham, of the Agricultural College, presiding, and on "The University and the Professions," with Chief Justice Carl V. Weygandt, of the Supreme Court of Ohio, as the presiding officer. Speakers at the agricultural conference will be Dr. Albert R. Mann, vice-president of the General Education Board, New York, and Dean Walter Coffey, of the College of Agriculture of the University of Minnesota. Dr. Roscoe Pound, dean emeritus of Harvard Law School, and Dr. Morris Fishbein, secretary and editor of the *Journal* of the American Medical Association, will speak at the conference on the professions.

ABSTRACTS for papers to be presented before the December meetings of Section I of the American Association for the Advancement of Science should be in the hands of the secretary of the section, Dr.

Leonard Carmichael, Tufts College, Massachusetts, by November 4. The abstracts should be about one hundred and fifty words.

THE issue of *Nature* for September 14 contains the following announcement: "For the time being the printing and publication of *Nature* may be delayed. Readers may be assured, however, that such delay, if any, will be kept to the minimum."

THE program of the meeting of the New York State section of the American Physical Society, which will be held at Syracuse University on October 26, includes a paper by Professor P. J. W. Debye, of Cornell University, on "The Influence of Atomic Motion on Interference Diagrams" and one by W. H. Carrier, entitled "Physics in Air Conditioning." On the previous evening Dr. Robley Evans, of the Massachusetts Institute of Technology, will deliver the Sigma Pi Sigma public lecture. He will speak on "Some Medical Applications of Nuclear Physics."

THE Society of Rheology meets at the American Museum of Natural History on October 18 and 19. Technical sessions were planned for both days. After the annual dinner on Friday evening Dr. Roy Waldo Miner, curator of living vertebrates at the museum, was expected to give a lecture entitled "Beneath the Seas for Museum Exhibits."

THE twentieth annual meeting of the Highway Research Board of the National Research Council will be held in Washington at the building of the National Academy of Sciences during the week beginning December 2. Sessions will be held on Wednesday, Thursday and Friday, December 4 to 6. According to the tentative schedule released by Roy W. Crum, director of the board, the Departments of Design, Materials and Construction, Maintenance, Economics and Soils and the Committee on Roadside Development will hold meetings on December 3 which will be open to the public. Board sessions will start on Wednesday morning, with the discussions centered about materials and soils investigations. On Wednesday afternoon topics relating to highway economics will be discussed; on Thursday morning, traffic; on Thursday afternoon, design and roadside development, and on Friday morning, finance and maintenance.

A SPECIAL dispatch to *The New York Times* states that the Pan American Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere was signed at the Pan American Union on October 12 by the United States and six Latin American republics. Diplomatic representatives of Cuba, El Salvadore, Nicaragua, Peru, Venezuela and the Dominican Republic joined Cordell Hull, Secretary of State, in affixing their signatures. The new agreement would bind the signatories to create national parks, wilderness reserves and wild life sanctuaries in their territory. It is open for the signature of all other countries in the Western Hemisphere. The governments pledge themselves to preserve natural scenery, striking geological formations and regions containing objects of esthetic, scientific or historic interest. The convention also urges the granting of permits for the killing and capturing of certain species to scientific expeditions only.

IT has been announced that the 1941 convention of the American Association of Cereal Chemists will be held in Omaha, Nebr., from May 19 to May 23. R. M. Sandstedt, of the Nebraska Experiment Station, is chairman of the program committee. J. M. Doty, Omaha Grain Exchange, is chairman of the local committee. The officers of the association as elected at the recent New York convention are as follows: *President,* Claude F. Davis, Noblesville Milling Company, Ind.; *Vice-president,* Charles N. Frey, The Fleischmann Laboratories, New York; *Secretary,* Jim Doty, Omaha Grain Exchange Building; *Treasurer,* Perie Humold, Southwestern Milling Company, Kansas City, Kan.; *Editor-in-chief of Cereal Chemistry,* M. J. Blish, Berkeley, Calif.; *Managing Editor of Cereal Chemistry,* R. M. Sandstedt, Agricultural Experiment Station, Lincoln, Nebr.

THE "Graduate Fortnight" of the New York Academy of Medicine opened on October 14. The course consists of twenty-seven evening addresses on the origin, diagnosis and treatment of infections, involving the principal systems and organs of the body, with special reference to chemo-therapy. Clinics and clinical conferences are being held in twenty-one of the leading hospitals of the city. The scientific exhibit is at the New York Academy of Medicine. It includes items on the history of infections affecting various parts of the body. Dr. Malcolm Goodridge, president of the New York Academy of Medicine, gave the address of welcome on the evening of October 14 to visiting physicians and fellows of the academy.

IT is reported that the late William J. Wollman, securities broker, left a net estate of $7,233,926, of which a residuary estate of approximately $6,000,000 is left in trust for the benefit of his sister, Kate Wollman, the principal to be used after her death for "public, charitable, educational or scientific uses and purposes." The William J. Wollman Foundation was set up in 1938 for the purpose of administering this trust.

THE October number of *Current Geographical Publications,* issued by the American Geographical Society of New York, initiates a service of interest to geographers, teachers, writers and workers in many fields. Each number will have as a special supplement a classified list of photographs contained in publications received in the American Geographical Society's library and indexed in its Photograph Catalogue. The Supplement is sent to all subscribers to *Current Geographical Publications* and can also be obtained separately.

DISCUSSION

THE SPAWNING MIGRATION OF THE SALMON

LITTLE is known concerning the factors guiding the migratory movements of the salmon. However, there are certain facts recognized by all workers in the field. (1) There are definite spawning grounds that are visited by specific species of salmon year after year. (2) Salmon runs have been established where no member of the species could ever have visited before being established.[1] (3) Salmon runs have been developed in virgin streams without having been planted. The best illustration is found in New Zealand, "Not a single individual of the quinnat species has ever been planted in a Canterbury stream, yet the Canterbury rivers now provide the best quinnat fishing in the Dominion, the species having migrated to their mouths from the Waitaki, where the original fry were planted."[1] (4) Efforts to establish salmon runs in certain other streams have failed. (5) Finally and most significant of all, repeated efforts to reestablish salmon runs in rivers now much modified which originally supported the particular species have failed. It is this last fact that has prompted me at this time to give a summary of my investigations on the physicochemical behaviors of waters as factors in the spawning migration of the salmon, which in due time will be published in *Ecology*. No one doubts that there are regularly recurring cycles in the physiological activity of the salmon, of ocean currents and of physico-chemical conditions of the sea water and of waters of spawning streams that regulate and guide the migratory movements of the salmon. The controversy is over the cause or causes of these movements or the guiding force or factors and the details of the paths over which the salmon travel. Knowledge of these factors in conserving the salmon is of less vital importance so long as the conditions remain *in statu quo*. On the other hand, knowledge of these factors becomes of vital importance when we are faced with the possibility of profound changes in one or more of these regularly recurring chains of events by the building of reservoirs. If any link of the chain of events is broken or misplaced the salmon runs of that particular stream might possibly be doomed.

Carbon dioxide tension of the blood is known to have far-reaching effects upon the physiology of respiration of vertebrates including fishes. In mammals the carbon dioxide tension of the blood is nicely regulated by the rate of ventilation of the lungs. The author has shown in various researches that fishes must of necessity depend more upon the carbon dioxide tension of the water to regulate the carbon dioxide tension of the blood. In view of these facts and the additional fact that volume of stream flow facilitates salmon runs into spawning streams I decided to determine the effect of different mixtures of fresh and sea waters upon the carbon dioxide tension of the mixtures.

The following is a summary of this investigation. It was found that the carbon dioxide holding capacity of a mixture of fresh water with a low alkalinity, and of sea water was always greater than the sum of the carbon dioxide holding capacities of the two waters before they were mixed. This simply means that the carbon dioxide tension of the mixture, without addition or loss of carbon dioxide, is always less than the carbon dioxide tension of the two waters before they were mixed. The lower the alkalinity of the fresh water the greater the reduction of the carbon dioxide tension of the mixture. On the other hand, the higher the alkalinity of the fresh water the less the reduction of the carbon dioxide tension of the mixture. With a very high alkaline fresh water the reduction is nil. It was also found that the increase in the carbon dioxide holding capacity of a mixed fresh water and sea water is greater in the high fresh water-sea water ratios than in the lower ratios and the very high ratios. In other words, there is a peak in the increase in the carbon dioxide holding capacity of mixed fresh and sea waters at high fresh water-sea water ratios. This increase is reduced rapidly as the ratios increase and less rapidly as the ratios are decreased.

The mixing of fresh water from the rivers, spawning streams, with the sea water of the ocean is an ever continuous process. Since the lowering of the carbon dioxide tension is greater in the higher fresh water-lower sea water mixtures than in the lower fresh water-higher sea water mixtures there is an uphill gradient of carbon dioxide tension of the water from near the mouths of rivers out into the ocean as far as there is a fresh water-sea water mixture. There is still another fundamental fact. Just as soon as the carbon dioxide tension of a fresh water-sea water mixture is lowered below the carbon dioxide partial pressure of the atmosphere carbon dioxide will be taken up from the atmosphere by the fresh water-sea water mixture. With a further concentration of sea water it can be shown mathematically that the carbon dioxide tension of the more concentrated sea water would then be higher than the carbon dioxide partial pressure of the atmosphere. This would form a "ridge" or "peak" of high carbon dioxide tension water on the outer edge of the diluted sea water. There would then be a carbon dioxide tension gradient from the mouths of rivers out to the extent of their diluting influence into the ocean. This area would in turn be bounded by waters having carbon dioxide tensions higher than the carbon dioxide partial pressure of the atmosphere.

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[1] F. A. Davidson and S. T. Hutchenson, *U. S. Dept. Com., Bur. Fish., Bull.* 26: 667–692, 1938.

The question is now raised, do fishes respond to a gradient of carbon dioxide tension water? Researches that have been carried on indicate that fishes do respond to a carbon dioxide tension gradient. Brilliant work done in the field of mammalian physiology has shown that the carotid bodies are sensitive, though to a less extent than the respiratory center, to a change in carbon dioxide tension of the blood. The carotid bodies alone are responsive to low oxygen tension of the blood. It is a well-known fact among all biologists that fishes avoid the high carbon dioxide tension and low oxygen tension hypolimnion water of a stratified lake. Now going back to our area of sea bounded by a "ridge" of high carbon dioxide tension it is obvious that if a salmon should cross this ridge it would be in an area dominated by another river and would be a stray (see discussion that follows).

It is a well-known fact that there is an increase in protein metabolism in the salmon when approaching sexual maturity. Increased protein metabolism tends toward acidosis, *i.e.*, a lowering of the alkali level of the blood. It is suggested that this lower alkali level of the blood brings about a response to a lower carbon dioxide tension of the water. At first this might constitute a drift, wandering, that would carry the salmon that were approaching sexual maturity, but not the immature, into lower carbon dioxide tension water. The carbon dioxide tension gradient is still steeper in the lower carbon dioxide tension water. The protein metabolism of the salmon is further increased as it approaches nearer sexual maturity. This still lower alkali level of the blood increases the response to lower carbon dioxide tension water which is more effective since there is an increased carbon dioxide tension gradient. The salmon finds the spawning streams by following the carbon dioxide tension gradient. The steeper the gradient, *i.e.*, the greater the volume flow of the stream, and the nearer the approach to sexual maturity the more vigorous the response of the salmon. When the salmon reach the mouth of the river they respond to current and ascend the spawning stream.

These suggested behaviors of the salmon are in complete accord with all known facts concerning the migratory movements of the salmon. It also explains why the immature salmon do not enter rivers *en masse*. The cycle is physiological, sexual and less environmental, seasonal. Of course we all understand that all physiological and sexual cycles are tied up with the environment, *i.e.*, seasonal.

The spawning ground chosen is a matter of reactions to environmental factors.[2]

These views are in keeping with Huntsman's[3] findings that salmon are held within the influence of natal streams, the "parent stream" theory and the specific races of the European workers. These are all discussed in the forthcoming paper. The author is well aware that much detail remains yet to be worked out. The author also wishes to emphasize the fact that no one factor can be responsible for all migratory movements of salmon.

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THE PERIODIC DIE-OFF IN CERTAIN HERBIVOROUS MAMMALS AND BIRDS

GREEN and others[1,2] have recently found that the cyclic decline of hares (*L. americanus*) in Canada is due in the main to a non-infectious disease which they call shock disease. The animals die suddenly in convulsions from a hypoglycaemic shock, due to degeneration of the liver with resultant failure of glycogen storage. The authors surmise that a similar disease may account for the four-year cycle in mice, since similar symptoms have been noted in these animals without any infectious agent being demonstrable. The cause of this liver damage in *L. americanus* has not been found, but several explanations are suggested, one of them being that "the increasing population may eradicate certain plants that contain food elements essential for the maintenance of healthy populations."

Now, there are some peculiarities in the behavior of the animals which do suggest deficiencies in the food, more specially mineral deficiency. The Danish civil engineer, Mr. J. O. B. Petersen, who has been working for several years in the northern parts of the Canadian forests, told me that "the rabbits" during their peak in numbers were very eager to gnaw or lick at anything which had been touched by sweaty hands; they could even be a nuisance in attacking measuring instruments, etc. This was not observed at other times; it was even possible to know whether a thrown-away boot had been lying in the forest since the last maximum, since in that case the sole would be gnawed away by the hares. As a matter of fact this behavior has been recorded (as a curiosity) by Soper,[3] who during a period of maximum abundance observed from traces in the snow how the animals had assembled in the night, nosing up to "every conspicuous object about camp—the water pail, axe, overturned boots, etc." The occasional carnivorous habits also referred to by Soper would seem to be restricted—at least mostly—to years of maximum abundance. Many other cases of depraved appetite in herbivorous mammals could be cited. Jacobi,[4] in his monograph of the reindeer, has brought together many interesting instances. We are concerned here with symptoms known to indicate mineral deficiency. It is not necessary to look for special food plants, the lack of which may bring about fatal results, because most plants are known to vary enormously as to minerals.[5] To veterinarians it is a familiar fact that serious diseases may result from deficiencies of minerals in pasture, and there is no reason why wild animals living on the same food should not be affected in a similar way. While, to judge from cattle pathology, the lack of certain "trace" elements (Cu., Co) occurs in restricted areas only, it appears that deficiencies affecting the acid-base balance are sufficiently wide-spread to account for the sudden drop in health observed in herbivorous mammals and birds at certain times. As an instance of such diseases in cattle may be mentioned licking disease, the name of which is derived from symptoms strikingly similar to those referred to above; even liver damage has been observed.[6] It is caused by a deficit of K (and Na) in proportion to the sulfuric and hydrochloric acids formed when the grass is digested. The enormous variations in this proportion found from year to year[7] are dependent on bacterial processes in the soil, and these in turn are said to be influenced to some extent by climate.[8] On the whole, climatic conditions appear to be one of the set of factors influencing the mineral contents of plants, and moreover the various elements are not affected alike.[9] It may be possible therefore to account for the regularity of the cycles in numbers by oscillations in the biological and chemical processes in the soil regulated by or adjusted to climatic cycles.

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[2] E. B. Powers, Publ. Amer. Assoc. Adv. Sci., No. 8: 72–85 and citations, and H. B. Ward, Publ. Amer. Assoc. Adv. Sci., No. 8: 60–71.

[3] A. G. Huntsman, SCIENCE, 85: 582–583, 1937.

[1] R. G. Green and C. L. Larson, *Amer. Jour. Hyg.*, Baltimore, 28: 190, 1938.

[2] R. G. Green, C. L. Larson and J. F. Bell, *Amer. Jour. Hyg.*, Baltimore, 30: 99, 1939.

While it is true that the ten-year cycle in hares, ruffed grouse, etc., can not be correlated with sunspots,[10] a well-marked climatic oscillation of the same average length seems, nevertheless, to exist,[11,12] and parallels to the cycles of four years in mice, and six years in red grouse[13] and crossbills,[14] are also found in meteorological literature.[15,16] These climatic cycles may need further confirmation, but their close agreement as to length with the biological ones, in spite of the fact that in most cases these have been unknown to the authors, strongly suggests that they are real. Elton's[17] theory that the fluctuations in numbers are caused by meteorological cycles seems so far confirmed, but there is probably general agreement to-day that it is impossible to explain the phenomenon by *direct* climatic influence on the animals, as was at first supposed.

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PURIFICATION OF THE PITUITARY INTERSTITIAL CELL STIMULATING HORMONE[1]

THE paper by Shedlovsky, Rothen, Greep, van Dyke and Chow[2] on "The Isolation in Pure Form of the Interstitial Cell-stimulating (Luteinizing) Hormone of the Anterior Lobe of the Pituitary Gland" reports results in such contrast with those found in our own laboratory[3] that we consider it important to emphasize these differences.

Both papers describe the preparation of an apparently pure protein with similar biological properties, the minimal effective dose (MED) also happening to be the same. The evidence for belief in the purity of the substance herein reported is as follows:

1. *Specificity of biological behavior.* The substance has a specific effect on the ovary and testis of hypophysectomized immature rats—the repair of the interstitial cells. When injected intraperitoneally into normal immature female rats, it reduces the potency of certain concordantly administered gonadotrophins (pregnant male serum and chorionic gonadotrophin). When injected into hypophysectomized immature males, it stimulates the accessory organs of reproduc-

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[3] Soper, *Jour. Mammal.*, Baltimore, 2: 104, 1921.

[4] Jacobi, *Zool. Anz.*, Leipzig, 96 Ergb.: 226, 1931.

[5] A. H. Word and Wakeham, *Univ. Colorado Studies*, 25 (3): 181, 1938.

[6] Lars Slagsvold, 4—*Nordiska Veterinärmötet*, Helsingfors, 1933, 203, 1934.

[7] J. Ibele, *Landwirtsch. Jahrb. f. Bayern*, München, 6: 195, 1916.

[8] T. Hedlund, *Svenska Mosskulturfören. Tidskr.*, Jönköping, 39: 122, 1925.

[9] J. B. Orr, "Minerals in Pastures," London, 41: 1929.

[10] D. A. MacLulich, *Jour. Roy. Astron. Soc. Canada*, 30: 233, 1936.

[11] Walther, *Ber. Deutsch. Bot. Ges.*, 54: 1936, 616; 1937.

[12] F. W. Braestrŭp, *Ann. d. Hydrographie u. marit. Met.*, Berlin; 1940 (in print).

[13] A. D. Middleton, *Jour. Animal Ecol.*, 3: 241, 1934.

[14] J. M. Speirs, *Auk*, 56: 411, 1939.

[15] A. H. R. Goldie, *Quart. Jour. Roy. Met. Soc.*, 62: 81, 1936.

[16] F. B. Groismayr, *Ann. d. Hydrographiem u. marit. Met.*, Berlin, 121, 1937.

[17] C. Elton, *Brit. Jour. Exp. Biol.*, 2: 119, 1924.

[1] Aided by grants from the Board of Research of the University of California, from The Rockefeller Foundation and from Parke, Davis Company. Assistance was rendered by the Works Progress Administration, Project No. OP 665–08–3–30, Unit A–5.

[2] SCIENCE, 92: 178, 1940.

[3] C. H. Li, M. E. Simpson and H. M. Evans. "The Interstitial Cell Stimulating Hormone. II. Method of Preparation and Some Physico-chemical Studies." *Endocrinology*, in press.

tion. (In some strains, the stimulation is more limited than in others.) It augments the potency of the follicle-stimulating hormone (FSH) judged either by increase in follicular development or in uterine weights. It is to be emphasized that one half unit or 0.0025 mg of the substance, when combined with 2 RU of FSH, doubles the uterine weight in immature hypophysectomized rats. Shedlovsky *et al.* do not report tests essential for establishing the freedom of their material from contamination with other hormones of the anterior hypophysis. The substance herein reported is free of follicle-stimulating effects when given in 600-fold the MED for repair of the interstitial tissue; no thyrotrophic hormone was detected at the 0.50 mgm level in the one-day-old chick thyroid weight test; no growth-promoting activity or adrenocorticotrophic effect was detected in hypophysectomized rats when injected at a total dose of 8 mg in 10 days; the local crop test for lactogenic hormone was negative at 0.68 mgm.

2. *Chemical characteristics.* The protein contained 14.2 per cent. of nitrogen with approximately 4.5 per cent. of tyrosine and 1 per cent. of tryptophane. The carbohydrate content remained constant on repeated ammonium sulfate fractionation; analysis showed 4.45 per cent. mannose and 5.86 per cent. glucosamine.

3. *Physical study* (cataphoresis) has indicated the homogeneity of the protein. The schlieren picture obtained in the Tiselius apparatus showed only one boundary by scanning the whole field after electrolysis for 90 minutes. The mobility of the protein was found to be -6.36×10^{-5} in phosphate buffer of pH 7.53 and ionic strength 0.05 at 1.5° C. Electrophoresis experiments showed the isoelectric point to lie between pH 4.6 – 4.8. It is to be noted that in contrast with our results, Shedlovsky *et al.* obtained a mobility of 0.66×10^{-5} at pH = 7.86 and an isoelectric point of pH 7.45. It may therefore be said that although proteins with similar biological properties have been isolated by two laboratories, the results from electrophoretic study are so different as to forbid identification of the substances in question.

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THE BLACKENING OF COOKED POTATOES

THE blackening of cooked potatoes is a different process from the darkening that occurs when raw peeled potatoes are exposed to air; the latter darkening is known to be due to melanin. Although both darkening processes are oxidations, the synthesis of melanin involves an enzyme whereas the other type does not require one. Potatoes which did not darken when kept in an atmosphere of nitrogen during boiling and cooling blackened when removed to the air.

Certain properties, including the ultraviolet absorption spectra of the pigments from the darkened raw and cooked potatoes, were compared. Those of the blackened cooked portions differed markedly from the melanin and, moreover, showed properties similar to flavones.

HELEN NUTTING
MARION C. PFUND
CORNELL UNIVERSITY

SCIENTIFIC BOOKS

CATASTROPHISM VERSUS EVOLUTIONISM

The Material Basis of Evolution. By RICHARD GOLDSCHMIDT. 436 pp. New Haven: Yale University Press. 1940. Price $5.00.

THIS book contains the only basically new theory of organic transformation propounded during the current century. For notwithstanding the colossal literature concerning organic evolution which has accumulated since the publication of Darwin's "Origin of Species," only three main types of theories can be distinguished. One type is based on Lamarck's assumption of direct adaptation by inheritance of results of use or disuse of parts. Other theories are built on Darwin's principle of natural selection of the fittest variants produced by interactions of the organism's inherited structure with the external as well as internal environments. Theories of the third group assume autogenesis, that is, unfolding of the potentialities hidden in the organism, impelled by an urge toward development in a certain direction. According to all these theories organic transformation takes place by evolution, that is, gradually by accretion of more or less small changes. According to Goldschmidt, however, it occurs by cataclysmic upheavals rather than by summation of individually small steps.

Lamarckianism has become obsolete owing to its basic assumption having fallen short of experimental verification. Autogenesis has always been in conflict with the principle of causality in vogue in the materialistically-minded modern science. Darwinism underwent great changes because of the forward strides of genetics, but the unbroken continuity of ideas between the "neo-Darwinism" and Darwin's original theory is evident. The appearance of Goldschmidt's book connotes an at least temporary end of the undivided reign of neo-Darwinian theories. For Goldschmidt not only relegates natural selection to a place of relative unimportance, but in effect rejects evolution beyond the narrow confines in which it has been admitted to exist by Linnaeus and many creationists. His theory belongs to the realm of catastrophism, not to that of evolutionism; his break with the Darwinian tradition is almost complete, and his ideas are related to those of G. St. Hilaire rather than to those of any modern evolutionist. Only deVries has occasionally expressed himself in a language similar to Goldschmidt's, but this similarity proves to be a spurious one. Genetics has been considered the foundation of neo-Darwinism. Throughout his book Goldschmidt stresses the fact that his views are a result of his lifelong work in genetics, but it must not be forgotten that he has a splendid command of other biological disciplines as well. Goldschmidt's interpretation of genetic data is different from the rather generally accepted one.

Only the salient points of Goldschmidt's brilliantly developed and masterfully presented theory can be summarized here. Goldschmidt asserts a fundamental dualism of the processes of organic transformation by distinguishing microevolutionary and macroevolutionary changes. 'Microevolution by accumulation of micromutations—we may also say neo-Darwinian evolution—is a process which leads to diversification strictly within a species, usually, if not exclusively, for the sake of adaptation of the species to specific conditions within the area which it is able to occupy." This process has nothing to do with the origin of new species: 'the subspecies are diversifications within the species, but there is no reason to regard them as incipient species." On the other hand, "the change from species to species is not a change involving more and more atomistic changes, but a complete change of the primary pattern or reaction system into a new one. . . . One might call this different type of genetic change a systemic mutation. . . ." The effectiveness of systemic mutations is tremendous: "Macroevolution may proceed by large and sudden steps which accomplish at once what small accumulations can not perfect in eons, and this on the specific as well as on any higher level." "Species and the higher categories originate in single macroevolutionary steps as completely new genetic systems." The origin of mimetic resemblances, of mutual adaptations of flowers and insects, the transformation of *Sinanthropus* into *Homo sapiens* might have taken place thus suddenly. The bon mot of Schindewolf that "the first bird hatched from a reptilian egg" is quoted approvingly, although it is not clear to the reviewer whether Goldschmidt intends this to be taken literally. The role of natural selection in macroevolution "becomes reduced to the simple alternative: immediate acceptance or rejection."

Although, in the reviewer's opinion, Goldschmidt's theory is invalid, it must be admitted that Goldschmidt has marshalled an impressive array of evidence in its favor. If races are not incipient species, if species arise by changes akin to explosions, the living world must be divisible into discrete species compartments. The lack of universality of such rigid subdivisions is what has ever since Darwin been one of the main arguments in favor of evolution. The first 183 pages of Goldschmidt's book are devoted to disproving this argument. The alleged transitional cases between races and species are scorchingly criticized and shown, according to the author, to be spurious. He admits that there are transitions between some of the "species" of the taxonomists, but these are not deemed to be real species. Goldschmidt has no crusading zeal to induce taxonomists to abandon their errors, but he insists that to an evolutionist "Where species can be distinguished with certainty . . . they are different and are separated by a gap, if not by an abyss." However, no definition of what a real species should be is given, so that one is left wondering how to detect them in practice.

Pages 184–250 contain the climax of Goldschmidt's theory: the statement of the case for systemic mutations. "A systemic mutation (or a series of such), then, consists of a change of intrachromosomal pattern," and involves "only the arrangement of the serial chemical constituents of the chromosomes into a new, spatially different order. . . ." An excellent review of the data showing that species differ in the linear sequence of materials (gene arrangement) in the chromosomes is given, and the conclusion is reached that the source of macroevolutionary changes is herein detected. A thorny question obtrudes, however, in the reviewer's mind. According to Goldschmidt, genes do not exist, and what has been known as gene mutation (the microevolutionary one!) is based on very small pattern changes in the chromosomes. What, then, is the fundamental difference between the ordinary mutations and systemic mutations?

Next (pp. 250–395), follows the chapter on "Evolution and the potentialities of development," in which Goldschmidt seeks to prove that the normal embryogeny contains potentialities which, when evoked by a genetic change, may lead to a complete reorganization of the end product. Here Goldschmidt is really at his best: pertinent facts from experimental embryology, comparative anatomy and physiology, unknown to or ignored by many geneticists, are organized into a logical and convincing system. It is difficult not to agree with Goldschmidt's conclusion that "The physiological balanced system of development is such that in many cases a single upset leads automatically to a whole series of consecutive changes of development. . . . If the result is not, as it frequently is, a monstrosity incapable of completing development and surviving, a completely new anatomical construction may emerge in one step from such a change." Whether or not the production of such "hopeful monsters" may reasonably be considered the main channel of organic transformation is, however, an entirely different matter, as Goldschmidt himself admits (p. 251).

It is impossible to attempt here a critique of Goldschmidt's theory, for this would require a book approximately of the same size as his own. Certain lines which such a criticism might take are adumbrated above. In his concluding chapter (pp. 396–399), Goldschmidt indicates that one of the advantages of his views over neo-Darwinism is the simplicity of the former. It is indeed simpler to assume that major groups of organisms arose ready-made by catastrophic systemic mutations than to visualize the complex interplay of the numerous agents which could bring similar results on the neo-Darwinian scheme. But in the reviewer's opinion the simplicity of Goldschmidt's theory is that of a belief in miracles. It must, nevertheless, be recognized that Goldschmidt's keenly critical analysis has emphasized the weaknesses and deficiencies of the neo-Darwinian conception of evolution, which are numerous, as even partisans ought to have the courage to admit. It would seem that this fact alone obliges any one interested in the modern evolutionary thought to read Goldschmidt's book.

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REPORTS

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY AND THE NATIONAL DEFENSE PROGRAM[1]

PROTECTION of the Western Hemisphere and especially of the North American continent against any possible invasion by force is the firm determination of all true Americans. Equally important, and more difficult, is defense of the freedom of spirit and action which our forefathers won for us by generations of struggle and which is stealthily threatened alike by subversive influences from without and vicious ambitions from within. Both tend to undermine our strength by sowing doubt and discord. Sometimes these influences operate insidiously in the guise of high idealism, as in the cause of peace or of human rights; sometimes they operate openly to incite violence and class hatred.

Research work on national defense problems is being conducted in many of the departments of the institute. Most of this is through contracts with the War and Navy Departments, the National Advisory Committee for Aeronatuics, the National Defense Research Committee, the National Academy of Sciences and with private companies engaged in development of equipment for military purposes.

Members of the institute's staff are serving in a variety of national defense agencies, some having been granted leaves of absence and others having been relieved of a portion of their institute duties to make this possible. Dr. Robert G. Caldwell, dean of humanities, is serving as chairman of the Division of Cultural Relations Among the American Republics, a post he has taken at the request of President Roosevelt. Professor Ralph D. Bennett, of the department of electrical engineering; Professor Francis Bitter, of the department of metallurgy, and Doyle Northrup, of the department of physics, are on leave of absence to carry on an important research program for the Navy Department, while Professor C. M. Van Atta and R. D. Campbell resigned from the physics staff to work on this project.

Professor Jerome C. Hunsaker, head of the departments of mechanical engineering and aeronautical engineering, is a member of the National Advisory Committee for Aeronautics, and is participating in the aeronautical research programs conducted for the Army and Navy by that committee. Through membership in many other boards and committees in Washington he is also aiding the defense program. Professor Walter G. Whitman, head of the department of chemical engineering, is chairman of a subcommittee of the National Advisory Committee for Aeronautics. Professor E. S. Taylor, of the department of aeronautical engineering, has been the chief assistant to George J. Mead, a graduate of the institute, who is in charge of airplane engine production under Mr. Knudsen, head of the National Defense Committee.

Professor John E. Burchard, director of the Bemis Foundation of Technology, is in active charge of a group of scientists and engineers charged with the development of special types of shelters.

Professor Douglass V. Brown is head of the Division of Economics and Statistics for the Stettinius Committee, and his colleague, Professor Douglas M. McGregor, has been called from time to time to undertake special assignments for the Bureau of Labor Statistics.

The National Defense Research Committee, under the chairmanship of our colleague, Dr. Vannevar

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[1] From the annual report of President Karl T. Compton to the Corporation of the Massachusetts Institute of Technology.

Bush, formerly vice-president and dean of engineering at the Massachusetts Institute of Technology, has presently available a large fund for research on devices and instruments of warfare. Members of the committee in charge of its four divisions are Dr. Frank B. Jewett (M. I. T., '03), Dr. Richard C. Tolman (M. I. T., '03), President James B. Conant, of Harvard University and myself. Among the committee's section chairmen are Dr. Alfred L. Loomis, of the corporation; Professor W. K. Lewis, department of chemical engineering, and Professor George R. Harrison, department of physics, and on the operating section committees are Professors Tenney L. Davis, chemistry department; Thomas K. Sherwood, chemical engineering department; Edward L. Bowles and Samuel H. Caldwell, both of the electrical engineering department.

These are only some of the present national defense activities of our staff. Many others also will undoubtedly arise in the near future.

Where we possess facilities of personnel or equipment which can contribute in especially significant ways to the national defense program, we should direct them to this effort, always guided by our best evaluation of the national importance of this effort in comparison with other ways in which these same personnel and facilities might be used. We should make this possible by postponing less urgent research projects, by internal rearrangement of teaching schedules and by carrying a more than normal per capita burden of work.

In addition to scientific and engineering research, special courses in various scientific fields have been given and others are expected to follow as the need arises. One of these was an intensive course for junior aeronautical engineers. Fifty-one graduates in civil, mechanical and other engineering subjects from engineering schools in northeastern United States were accepted for this ten weeks' course without tuition. The success of the program has led to requests by aircraft companies that the course be repeated and that similar training be offered in other fields. Congress has under consideration an appropriation of $9,000,000 for financing short intensive courses in engineering schools.

Technology is continuing to participate in the Civilian Pilot Training program and is planning to speed up the ground school program during the current academic year.

Weather forecasting is an essential feature of modern warfare. For a number of years the institute has been giving postgraduate training in meteorology to young men of the Army, Navy and the United States Weather Bureau. This summer a special intensive course was given to recruits for the meteorological service of the Army Air Corps. During the current academic year, training will be given to another group of approximately sixty-five special postgraduate students in this subject, mostly from the Army Air Corps and the Weather Bureau. With these additions we have had a threefold increase in the number of graduate students studying meteorology.

Realizing fully that present conditions make it more important than ever that it keep abreast of advances in science and engineering and that its officers must have the best possible technical training, the Navy Department is sending an increased number of officers for postgraduate study at the institute. At its request there has been established a new course which combines the separate courses in naval construction and naval engineering into a single coordinated program. Of the sixty officers detailed to technology, forty are taking this three-year program and the remainder are distributed among other courses.

As the need arises we are preparing to institute intensive new courses in naval construction and aircraft instruments for special groups of officers.

The Wright Brothers Memorial Wind Tunnel is in continuous and overtime use for the testing of design models of new types of airplanes. With funds provided by two aircraft companies, important new equipment is being added to this laboratory to permit tests on models with power applied to propellers, thus more closely simulating flight conditions.

SPECIAL ARTICLES

PROPERTIES OF THE ISOLATED EQUINE ENCEPHALOMYELITIS VIRUS (EASTERN STRAIN)[1]

REPORTS from this laboratory during the past two years have been concerned with the purification of the virus of equine encephalomyelitis and the study of its properties. Of chief interest has been the investigation of a specific material obtained by ultracentrifugal fractionation of extracts of chick embryos diseased with the virus (Eastern strain). With this material, first described by Wyckoff,[2] is associated the infectivity of the extracts from which it is derived. Continued study has provided increasing evidence that it is identical with the virus.

The process consistently yielding the purified virus has already been described.[3] Obtained after three cycles of alternate low- and high-speed ultracentrifugation, the purified substance, dissolved in solution of 0.1 M or greater salt concentration, exhibits the homogeneity of a single molecular species[3] in the analytical ultracentrifuge. The sedimenting boundary is sharp, comparable with the boundaries seen with the papilloma virus[4] and reported for the tobacco ring-spot virus[5] though not with those of certain other plant viruses such as that of tobacco mosaic. Unsedimentable light-absorbing substances are not present nor are more than traces of material sedimenting more rapidly than the virus. The sedimentation constant is $S_{20}^{\circ} = 253 \times 10^{-13}$ cm sec^{-1} dynes^{-1}.

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[1] This work was aided by grants from Lederle Laboratories, Pearl River, N. Y., and the Dorothy Beard Research Fund.

[2] R. W. G. Wyckoff, *Proc. Soc. Exp. Biol. and Med.*, 36: 771, 1937.

Solutions containing 0.1 per cent. virus are opalescent and give the usual protein tests. The Molisch test is initially negative, but positive tests for pentose with orcinol and sulfuric acid and Bial's reagent are obtained. The Schiff test for aldehydes is strongly positive and so, too, is the acrolein test for fat. A sample containing 0.25 per cent. virus heated gradually (2° per minute) becomes opaque at 56.0 to 58.0° C. The denatured material is insoluble, its initial infectivity is lost, and the nitroprusside test is negative. Dialysis against distilled water leads to precipitation and partial inactivation of the virus, and the salt-free material frozen and dried *in vacuo* is further inactivated and insoluble in saline solutions.

The results of chemical fractionation and analysis are summarized in Table 1. For this about 300 mg of the homogeneous material with an initial infectivity of about 10^{14} mouse infectious units per gram was dialyzed against distilled water, frozen and dried *in vacuo* and then dried to constant weight over P_2O_5. The lipoid fraction was obtained by extraction in turn with acetone, alcohol-ether (1 – 1) and benzene. From a solution of the whole lipoid fraction in chloroform, phospholipids were precipitated with strontium chloride and acetone.[6] The precipitate was completely soluble in moist ether and contained practically all the nitrogen and phosphorus of the whole lipoid fraction. The weight of this phospholipid subfraction was calculated from the phosphorus value with the factor 26. Cholesterol was determined upon an aliquot of the acetone fraction and was completely precipitable with digitonin. Fatty acid was calculated as oleic acid. The presence of aldehydes in the lipoid fraction was indicated by a strongly positive test with Schiff's reagent.

TABLE 1

FRACTIONATION AND ANALYSIS OF THE EQUINE ENCEPHALOMYELITIS VIRUS (EASTERN STRAIN)

	Whole virus	Virus fractions							Yeast nucleic acid
		Lipoid				Carbohydrate†	Protein		
		Total	Phospholipid	Cholesterol	Fatty acid	Total	Total	Nucleic acid	
Per cent. of whole virus		54.1*	35	13.8	9.6	4.0	49.1*	4.4	
Per cent. of fraction			64	24.0	18.0			9.0	
C (per cent. dry weight)	62.2								
H " "	9.2								
N " "	7.7	1.5	2.0				14.1	14.1	13.3
P " "	2.2	2.4	2.5				1.2	7.3	7.9
Residue " "	2.8								
Carbohydrate† " "	4.0	1.6					7.2	33.6	33.2
N : P	3.6 : 1	1 : 1.6	1 : 1.2				1 : 11.7	1 : 1.9	1 : 1.7
Carbohydrate : P	1.8 : 1	1 : 1.5					6 : 1	4.6 : 1	4.3 : 1

* These values include the corresponding fraction of total carbohydrate.
† Carbohydrate as glucose.

The protein fraction remaining after lipoid extraction gave positive tests for pentoses and only a weakly positive Schiff test. From 57.5 mg of the protein fraction, 5.5 mg of material having the qualitative solubility and general properties of a ribose nucleic acid was obtained.[7] Practically all the phosphorus was removed from the protein in this subfraction. Samples weighing 0.25 to 0.3 mg gave positive orcinol and Bial tests, but were negative with the Feulgen test. Parallel tests and analyses were made with comparable weights of yeast and thymus nucleic acids. It is evident that the behavior and constitution of this virus nucleic acid are similar to those of yeast nucleic acid.

By pyknometer measurements on solutions of fully active virus the partial specific volume was 0.839, corresponding to a specific gravity of 1.19.

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[3] A. R. Taylor, D. G. Sharp, H. Finkelstein and J. W. Beard, *Proc. Soc. Exp. Biol. and Med.*, 43: 648, 1940.

[4] J. W. Beard, W. R. Bryan and R. W. G. Wyckoff, *Jour. Infect. Dis.*, 65: 43, 1939.

[5] W. M. Stanley, *Jour. Biol. Chem.*, 129: 405, 1939.

[6] R. J. Reiser, *Jour. Biol. Chem.*, 120: 625, 1937. We are greatly indebted to Dr. Reiser for his advice and aid in the analysis of the lipoid fraction.

[7] T. B. Johnson and H. Harkins, *Jour. Am. Chem. Soc.*, 51: 1770, 1929.

Molecular stability[8] is at a maximum between pH 7.0 and 8.5. When the pH is reduced below about 6.5, the virus precipitates, and its infectivity is rapidly lost.[9] Disintegration, occurring slowly in the optimum pH range and more rapidly above the optimum to about pH 10.5, takes place as a splitting off of relatively very small light-absorbing fragments. These fragments are evident in the sedimentation patterns above the still sharp boundary of the residual virus, which thus becomes progressively obscured. At pH levels above about 10.5, the sedimentation constant of the residual large component is greatly diminished. Exposure of the virus to ultraviolet light of 2537 Å results in inactivation at a rate of the same order of magnitude as that reported for certain bacteria.[10] Virus inactivated in this way to the extent of 7 decimal dilutions gives a slightly diffuse sedimentation boundary and the same sedimentation constant as that of the fully active material. The molecular stability of the inactive material is much less than that of the untreated virus, but the process of disintegration subsequent to irradiation appears similar to that of the intact virus. The nitroprusside test of the inactive material is negative.

The purified material studied is specific to the virus-diseased chick embryos. No trace of a similar or related component has been found in repeated studies of normal embryo tissue. The homogeneity of the product is clearly evident in the findings with the analytical ultracentrifuge and in the uniformity of its biological and chemical behavior. It would thus appear that the virus of equine encephalomyelitis (Eastern strain) is a complex of high molecular weight consisting of phospholipids, cholesterol, fatty acid and ribonucleoprotein.

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HYPERFUNCTION OF ANTERIOR PITUITARY IN RATS. II. ESTRUS CYCLES[1]

In previous papers[2,3] the authors have reported the following as evidence of a hyperactivity of the anterior pituitary in their colony of the Yale strain of rats: (1) high fasting blood sugar, (2) low glucose tolerance, (3) an exaggerated hyperglycemic response to epinephrine, (4) an initial resistance to insulin, (5) a high percentage of body fat, (6) an exaggerated rate of growth and adult size, (7) large urine volume and (8) high incidence of sterility. If these characteristics result from a hyperfunction of the anterior pituitary, one might expect to find a reflection of this activity in the estrus cycle.

Observations on 122 rats revealed a significant difference between the cycles of the Yale strain and the normal strain, although quantitatively the difference was not as great as that observed by Evans[4] following the injection of anterior pituitary extracts. The procedure consisted of comparing under controlled conditions the estrus cycles of the Yale strain with those of the Wistar strain which we consider normal for reasons previously enumerated.[2,3] Individuals from the two strains were matched according to age, type of cage, number per cage, degree of light exposure and diet. Smears were made each morning, and the first appearance of cornification was taken as the end-point.

In the first series of observations, 17 sexually mature rats ranging in age from 40 to 60 days at the inception of the experiment were selected from each strain and smeared daily for at least 3 cycles. The average cycle in days for the Yale strain was 5.8 P.E. ± 0.36 and for the Wistar strain 4.7 P.E. ± 0.36. There are 8 chances per 100 that the difference is not significant. Sixty-five per cent. of the Yales and 35 per cent. of the Wistars had average cycles of 5 days or more, and 35 per cent. of the Yales and 6 per cent. of the Wistars had average cycles of 6 days or more. The chances that these differences are not significant are 4 and 3 in 100, respectively.

The second series totaled 44 Wistars and 45 Yales ranging in age from 80 to 295 days. One Yale rat, 97 days of age, showed no cycle although smeared for 16 days. Table 1 shows that the cycles averaged 5.48 days for the Yales and 4.45 for the Wistars. The chance that this difference is not significant is less than 1 in 100. Thirty-four per cent. of the Yales but only 9 per cent. of the Wistars have cycles of 6 days or over. The chance that this difference is not significant is less than 1 in 10,000.

In view of the work of Blunn[5] on the relation of the genetic composition of rats to the time of opening of the vagina, it appears important to record that the Yale, more accurately called the Connecticut Agricul-

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[8] A. R. Taylor, D. G. Sharp and J. W. Beard, *Jour. Infect. Dis.* In press.

[9] H. Finkelstein, W. Marx, D. Beard and J. W. Beard, *Jour. Infect. Dis.*, 66: 117, 1940.

[10] D. G. Sharp, *Jour. Bact.*, 37: 447, 1939; 39: 535, 1940.

[1] This investigation was supported by a grant from the Committee on Research in Endocrinology, National Research Council.

[2] V. V. Cole and B. K. Harned, *Endocrinology*, 23: 318, 1938.

[3] B. K. Harned and V. V. Cole, *Endocrinology*, 25: 689, 1939.

[4] H. M. Evans, Harvey Lectures, 19: 212, 1924.

[5] C. T. Blunn, *Anat. Record*, 74: 199, 1939.

TABLE 1

A Comparison of the Lengths of the Estrus Cycles of Mature Rats in the Wistar and Yale Strains. Rats from the Two Strains Were Paired According to Age. Range 80–295 Days

Length of cycle in days	No. of rats showing cycle		P*
	Wistar 44 rats	Yale 44 rats	
3	7	5	
4	23	13	
5	10	11	
6	1	5	
7	2	3	
8	0	2	
9	1	3	
11	0	1	
14	0	1	
Average cycle in days ..	4.45 ± 0.13	5.48 ± 0.23	0.009
Percentage 3–5 days	91	66	0.00005

* Chance that deviation is due to sampling.

tural Experimental Station strain, and the Wistar experimental strain used in these studies are genetically different, as shown by the results of mating a piebald male with two Yale and two Wistar females. The 17 offspring from the Yale crosses were black with white paws and vest, while the 21 offspring from the Wistars were all piebald.

The data on the estrus cycle of the Yale rats have been interpreted as further evidence of a hyperfunction of the anterior pituitary in this strain.

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LIFE HISTORY OF SPIRORCHIS PARVUS (STUNKARD) TREMATODA: SPIRORCHIIDAE

The life history of *Spirorchis parvus,* a monostomate blood fluke from the arterioles of the muscular gut wall of the turtle *Chrysemys picta,* has been completed experimentally in the laboratory. The large non-operculate eggs contain active miracidia when passed from the host; hatching occurs after four to six days' incubation at room temperature. The miracidium is complicated, having a complex sensory apparatus, eighteen dermal plates arranged in four tiers and two pairs of flame cells. Miracidia penetrate young snails of the species *Helisoma trivolvis* Say and *H. campanulatum* Say and develop into elongated mother sporocysts in the mantle of the hosts. Young daughter sporocysts escape from the mother sporocyst sixteen to eighteen days after penetration of the miracidia and migrate to the liver of the snail by way of lymph channels. The young daughter sporocyst has a subterminal birth pore, a spinose anterior end, and contains several young cercarial embryos. The cercaria is an apharyngeal, distomate cercaria of the furcocercous, brevi-furcate type, having a dorsal body crest and compound pigmented eyespots. Body and tail are spinose. The body is humped above the insertion of the tail, broad posteriorly and narrow anteriorly to the ventral sucker. The mouth is subterminal as in schistosome cercariae; esophagus long, ceca short and inflated. The head organ is larger than the ventral sucker, the former is transformed within the final host into the oral sucker while the ventral sucker disappears. The tail-stem is muscular and more than twice the length of the body. The furcae have fin-folds. Both body crest and fin-folds are organs of flotation.

The crest is formed by an elevation of the cuticle above the dorsal mass, but the two cuticular portions are not in contact, thus forming a cavity between the apex of the crest and the dorsal body wall. The crest may be obliterated by extreme elongation of the body, or it may appear even higher than usual when the body is greatly contracted. It may disappear altogether when specimens are placed in hot fixing solutions, but it is demonstrable in specimens fixed in warm or cold solutions.

There are seven pairs of penetration glands in cercariae dissected from the snail, but only six pairs in naturally emerged cercariae. The seven pairs may be divided into four groups; the first group, found only in cercariae dissected from snails, consists of a single pair of small pyriform, mononucleated gland cells located about halfway between the eyespots and the ventral sucker. They and their ducts are filled with coarse granules. The second group contains two pairs of eosinophilic glands, located just anterior to the ventral sucker. The three pairs of glands in the third group are basophilic in staining reaction and are located dorsal and posterior to the ventral sucker. They are larger, more elongated and have more finely granular contents than the first two groups. The fourth group consists of a single pair of large glands located in the extreme posterior part of the body. In naturally emerged cercariae they appear as a single large granular mass and are so reported in related cercariae. The contents of these glands and their ducts are coarsely granular as in the first pair. During most of the developmental period of the cercarial embryo these glands are clearly separate. They migrate posteriorly from near the head organ, where they were first seen, to the posterior end of the body as the embryo grows into a fully developed cercaria. By this time the glands are so overlapped as to appear as one, but their ducts, which may be observed at any stage of development after their first appearance, indicate the paired condition. The presence of the first group of glands in cercariae dissected from snails and their absence in naturally emerged cercariae suggest that the contents of the first pair of glands are used by the cercaria to make its way through the tissues of its snail host.

The identity of *Cercaria parvus* was proved experimentally by rearing adult worms from cercariae and also by rearing cercariae from eggs produced by these adult worms. A detailed comparison of this species with descriptions of *C. wardi* Miller (1923) shows that they differ only in the presence of a dorsal crest on *C. parvus*. A corresponding structure was not described for *C. wardi*. Despite this apparent difference there is a possibility that they are identical. *C. parvus* in its position when floating or resting on the bottom differs from *C. elephantis*, which it closely resembles in structure.

A more complete description of the stages in the life history of this trematode and the development of its excretory system will be presented elsewhere. These researches were supported by a fellowship of the General Education Board.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN AUTOMATIC ZERO PIPETTE FOR DISPENSING STERILE CULTURE MEDIA[1]

An apparatus constructed in this laboratory in connection with chemical studies on the nature of disease resistance has proved to be convenient in sterilizing and aseptically dispensing measured amounts of liquid culture media into sterile flasks. It is particularly useful when large numbers of flasks are to be filled, as in testing the inhibitory effects of organic compounds using the alcohol sterilization technic described elsewhere.[2] The details are shown in the figure; the measuring device resembles the automatic zero pipettes commercially available but is especially adapted for aseptic use.

The apparatus was made of Pyrex glass throughout and requires one No. 7/25 Standard Taper joint and one three-way stopcock with 2 mm bore; the other parts are readily constructed by any one with an elementary knowledge of glass blowing.

To prepare the apparatus for autoclaving, an upright Erlenmeyer flask of appropriate size (generally 4 liters) containing the nutrient medium is closed with a two-hole rubber stopper bearing the measuring device and an air vent tube A. The stopcock is turned so that air can escape from the flask through the pipette and the openings are plugged with cotton as indicated. The L-shaped tube B leading to the stopcock is pushed as far as it will go into the rubber stopper so that a minimum of head room in the autoclave is required; the level of the liquid in the flask should be below the end of this tube. The air vent tube, which is made of a 2 mm capillary and extends to the bottom of the flask, is closed with a No. 0 rubber stopper to prevent loss of liquid through the tube; this stopper must be removed as soon as the autoclave is opened to prevent the solution from reaching the cotton plug. After the large stopper is fastened in place with the clamp, the top of the flask and the pipette are covered with a folded sheet of wrapping paper and the apparatus placed in the autoclave.

When the system has cooled and is to be used, the paper hood is removed, the stopcock turned to an off position and the L-shaped tube carefully pulled out of the stopper until the end is practically flush with inner surface of the stopper. The expanded rings C of the tube in the stopper aid in preventing any leakage or tendency of the tube to come out of the stopper

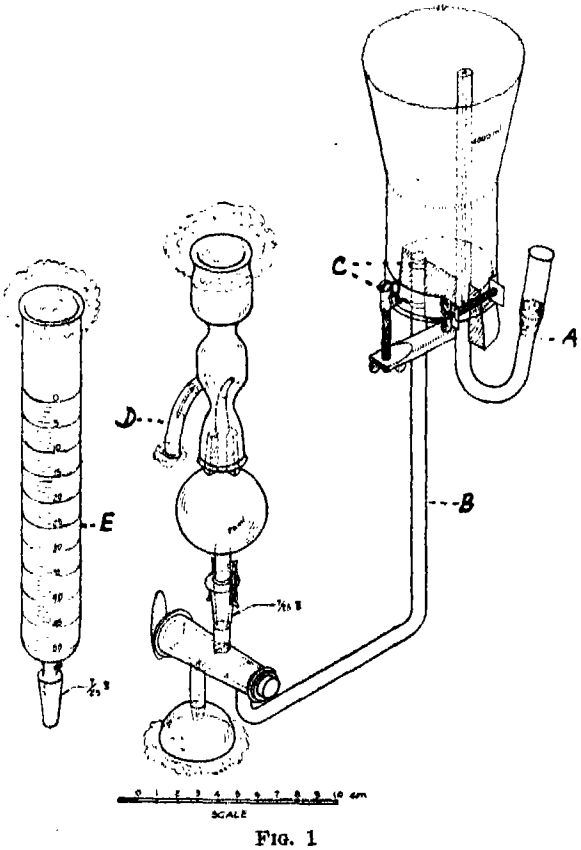

Fig. 1

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[1] Approved by the director as contribution No. 598, Technical Series, of the Texas Agricultural Experiment Station.

[2] Glenn A. Greathouse and Neil E. Rigler. Quantitative Comparison of Methods for Sterilizing Solutions of Organic Compounds Used in Culture Media. (In press.)

too readily. The apparatus, after being inverted, is placed in a large split iron ring attached to a ring stand and then has the appearance indicated in the drawing. The cotton in the side arm D of the overflow vessel is removed and a glass tube (not shown) is attached to it by means of a short rubber tube. This glass tube conducts the overflow to a beaker sitting on the table top. The 1 mm constriction in the side arm provides a liquid seal to prevent any chance of contamination through that member. The cotton plug is then removed from the bell-shaped shield and the apparatus is ready for use. The stopcock is turned so that the pipette fills. When a few drops of liquid have run out of the tip at the top, indicating that the pipette is completely filled, the stopcock is turned through 180° and the measured quantity is discharged into a sterile flask which is placed on the table underneath the bell. The interchangeable ground glass joint is provided to facilitate the use of various-sized pipettes from 10 to 100 ml. When different amounts of one solution are to be measured, but with less rapidity and accuracy, a graduated burette E can be inserted, instead of the pipette, by means of the interchangeable joint.

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A DRY-ICE FREEZING UNIT FOR CUTTING FROZEN SECTIONS

The advantages in time-saving of different freezing methods in cutting microscope sections is well recognized, but available techniques are in many cases difficult or costly to use. Freezing by carbon dioxide gas is both costly and tedious in practice. The use of commercially available dry-ice freezing units has some disadvantages. Ordinarily these units are too small for pieces of tissue larger than 2 square cm, they fail to freeze the tissue uniformly, since the dry-ice container is arranged on an arm extending from the tissue table, and they do not hold enough dry ice to keep the tissue at a uniform temperature for a sufficiently long period of time.

In order to facilitate the cutting of rather large brain sections, a dry-ice freezing unit has been devised to eliminate many of the difficulties described above. The unit is constructed so that it can be used on different kinds of microtomes.

Fig. 1 presents a diagram of the apparatus in cross-section. The device consists of a cylindrical cast-aluminum container, constructed with a center table, to which is fitted a bakelite support. The block of tissue to be sectioned is placed on the center table, which is grooved in concentric circles, and powdered dry ice is packed around it within the container. The bakelite support is clamped to the block-holder of the microtome.

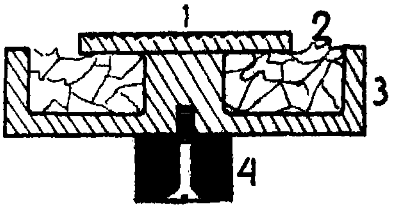

Fig. 1. The Dry-ice Freezing Unit: 1 represents the circular table of the freezing unit, 2, the circular container into which the dry ice is packed, 3, the side wall, and 4, the bakelite support, which is clamped into the block-holder of the microtome.

The dry-ice container measures 8.4 cm in diameter, 2 cm in height, and has a wall and base 0.4 cm thick. The tissue table is supported at the center of the container on a base 1.5 cm in diameter. The table itself is 5 cm in diameter and 0.5 cm thick, and is raised 0.2 cm above the wall of the container in order to avoid the possibility of fouling the knife. The hexagonal bakelite support is 1.5 cm high and 2.5 cm in width. Additional economy of space may be secured by constructing the apparatus so that the base support may be clamped directly in the microtome, thus eliminating the block-holder.

Using this device, complete frontal sections of the brains of large dogs, 30, 40 and 50 microns in thickness, have been cut very satisfactorily. The tissue is frozen uniformly since the tissue table is completely surrounded by dry ice. The dry ice keeps well, for it is partly enclosed within the container. Furthermore, the container is insulated from the metal of the microtome by the bakelite support. In these respects the freezing unit described has been found superior to other devices of this sort, both those which utilize dry ice or carbon dioxide gas in order to freeze the tissue.[1]

Karl U. Smith
The University of Rochester

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[1] The freezing unit described may be obtained from Merle Hanford, Physics Department, University of Rochester, Rochester, N. Y.

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ENGINEERING PROGRESS AND THE SOCIAL ORDER[1]

By Dr. FRANK B. JEWETT

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AT a time like the present, we all realize that something is on trial. Without perhaps being particularly aware of it, civilized man the world over is engaged in sifting and weighing evidence and will sooner or later reach certain conclusions. These conclusions are likely to be of fundamental significance as regards the future ordering of public judgment, and will differ no doubt in important respects from the basic tradition which, in the past, has been acceptable and accepted in guiding much of our action.

It would be very interesting to discover just what it is that stands before the bar. It may be fundamental science, it may be applied science, it may be science and technology in general, it may be religion, it may be domestic politics or world politics, or it may only be that old and primeval scapegoat, human nature, whom the bailiff never tires of bringing to book and who, we now begin to suspect, is quite incorrigible.

Here in brief is the setting for any contemporary discussion of science and technology and their repercussions on the social order. In attempting to identify what is here somewhat loosely designated as the culprit, it is perhaps well to recognize that the public at large will make up its mind irrespective of what any few individuals decide. However, a correct analysis is none the less important because every correct analysis helps to establish for the future our assurance that we are not utterly creatures of chance, but that if, as a social group, we make the requisite effort we will be able to gauge our social and political environment and build and modify it consciously, as we now control much of our material environment.

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[1] Address delivered before the Section on Natural Sciences of the University of Pennsylvania Bicentennial Conference, Philadelphia, September 19, 1940.

Let us begin with the truism that the major problems and troubles of the day have, in considerable measure, a technological and therefore a scientific heritage. Both our civilization and our civilization-destroying engines are mechanistic. In business and in industry—even in that much more fundamental unit, the family—the daily round has become pretty firmly geared to the machine. In optimistic moments we declare that this has brought leisure and has raised the standard of living; but if so, can we also affirm that it has brought liberty and peace of mind? Quite the reverse, for out of it has grown a powerful compulsion that we coordinate our individual and collective actions with almost machinelike precision to the complex activities that go to make up the present-day life of society. To the extent that we fail in our efforts at coordination, the complex social machine of which we are a part goes awry, yielding not plenty and profit but conflict and confusion. Therefore, we might conclude that we are in danger of being plagued by our own knowledge of material things. It manifests itself as a web of exquisite subtlety which, unwittingly, we have been weaving about ourselves. And unfortunately there appears to be no way in which the web can be unraveled. Knowledge once available is destined to be a permanent possession; for all our inventive skill we can conceive of no method by which facts once understood can be forced back into the limbo of the mysterious and the unknown. The road of learning which the human race has been traveling permits of motion in only one direction. To go backward necessarily implies that the species were to become something less than human.

CONSTRAINTS OF INDUSTRIALIZATION

A chief source of disquiet is that modern science in its own attainments and in its practical applications has emphasized as never before the gulf which separates the remarkable powers and the equally remarkable limitations of the human mind. In the face of such demonstrated limitations, we must all at times—and especially in the present crisis—have wished that they were not immutable so that something might be done to improve the breed, as it were. However, whatever the view we take toward eugenic programs and the uplifting influence of education, the only hope of prompt relief appears to lie elsewhere.

The mathematicians and physicists have a term which expresses precisely the change which accumulating knowledge seems to have made in our lives. There are in mechanics many problems which involve what are called constraints. The motion of the pendulum bob is a problem involving a very simple type of constraint. The string or wire which supports the pendulum weight converts the problem from that of a freely falling body to one which is compelled to oscillate to and fro indefinitely. The analogy is a good one, for our machines as they become hourly more complex and with more delicately balanced and interrelated parts, are constraining our lives to do likewise. Having created all manner of mechanical devices as aids to living we—as a people with instincts for gears and levers and close coordination—hesitate to sacrifice their marvelous efficiency by failing to meet the heightened standards of dexterity and cooperation on our part which their successful operation demands. The inevitable result is that our mode of living is becoming more and more determined by the presence of invisible but none the less compelling constraints.

What, then, is to be the antidote to our expanding knowledge of material things?

ALTERNATIVES VERY LIMITED

This is not the place to discuss whether our association with the mechanisms of which the constraints are concomitants imparts adequate recompense for the resulting loss of freedom. Time alone will answer this question. But since most of mankind gives evidence of being fascinated by mechanism as well as welcoming the excitement of teamwork—that is, of being a cog in a machine provided only that the machine appears to be going somewhere or accomplishing something and is running rapidly enough—it seems reasonable to suppose that the growth of constraining influences will of itself scarcely be regarded as an unwelcome curtailment of action.

But whether this is so or not, we are faced with a startlingly limited array of alternatives. Recent events in Europe are of course the chief source of evidence in this regard. Should this nation or any western nation decide now or at some future time that the machine era has, so far as it is concerned, begun to display diminishing returns, there might be little that it could do to extricate itself, for the constraints of the machine are not alone of a kind which *counsel* conformity on our part, they include another kind which might very effectively *compel* it.

To be sure, history records that no dictatorship has long endured, having always proved the prey of disruptive forces working either from within or from without or both. But in this respect will history be able to repeat itself? We lack no evidence that through science and engineering the essential paraphernalia of dictatorship are much more effective than ever before. It is probably not wide of the truth to say that a few squads of men with modern tanks are about as effective for purposes of offense as one of Caesar's entire armies. The unarmed mob, which in the past has so frequently been able to take matters into its own hands, is no longer a match for as much as a corporal's guard equipped with machine guns of recent design. And as a means of holding whole populations in submission, the airplane may prove itself to be a very decisive weapon. It has amply demonstrated that in densely peopled areas it can, unless strongly opposed, be the means of levying heavy toll upon civilian life and property, and apparently upon something even more vital, namely, civilian morale.

So it seems manifest that from the standpoint of the group—not alone the individual—we should regard very seriously the effort needed to overthrow authoritarian rule, once it becomes established; and this would be true even though it became utterly repugnant to its subjects. There is apparently something new to history—namely, the possibility that a minority can effectively secure control of a majority. We see not alone what can happen within national boundaries, as in each of the totalitarian states, but more significantly, we see an entrenched minority extend its sphere of conquest to much larger circles beyond its national boundaries.

While the full future consequences of these recent developments are not easy to gauge, it seems essential to attempt a re-evaluation of available political methods and instrumentalities, that we may thereby select those best suited to cope with the conditions obviously imposed by present-day technology. Our inherited social techniques give evidence of having lost an important measure of contact with reality. In an ideal sense one may still applaud Franklin when he said, "They that give up liberty to obtain a little temporary safety deserve neither liberty nor safety." But the vital fact to-day—and we see that it has but recently injected itself—is that a minority who are willing to sacrifice their own liberty, or who perhaps have been so unlucky as unintentionally to lose it, can compel a majority who cherish liberty to lose theirs. The most effective avenue of escape seems to be to find some way of preventing the minority from giving up their liberty. Failing this, little better than a Hobson's choice remains so far as the majority is concerned. They may elect either to lose their liberty by being worsted in a struggle for which they are improperly prepared, or if they act in time they may, by submitting in large measure to totalitarian methods, put themselves in condition to resist attack successfully. Now that mankind is in possession of the weapons made possible by modern technology, the planet has grown too small to support simultaneously the type of government which the modern dictators advocate and the type which we associate with liberalism. To combat the Nazi type of "total war" there is only one possibility—that of *total peace*.

The foregoing argument would only be strengthened were consideration given to such additional factors as wage, price and profit controls. Here again the liberal state as it now operates is at a distinct disadvantage. The authority necessary to establish such controls is entirely repugnant to the liberal way of life, except in so far as they can be worked out by voluntary acquiescence on the part of the individual. Yet the energetic waging of war—and in fact the energetic waging of commercial war in times of nominal peace—threatens to involve the equivalent of these authorities in the highly integrated modern industrial state and also in the world at large. In a word, unless the liberal nations, and those who would be liberal, have the world largely to themselves so that they can control the rules of the international game of give-and-take, they run a grave risk of proving but pawns in the hands of totalitarian powers.

Dangers in Planned Economy

Now it is proposed to discuss this situation not from the standpoint of the social sciences, but from that of the physical sciences and technology.

The purpose of the argument thus far has, of course, been to suggest that the free nations must alter in a fundamental fashion their methods of solving social and political problems. But let it be noted immediately that no planned economy will be advocated as the alternative. The gap which separates the planned economy from dictatorship is likely to be extremely narrow, if not in reality non-existent. It has frequently been pointed out that national planning, irrespective of the innocence with which it is launched or the beneficent ends held in view, will inevitably lead to dictatorship provided the political authority is created to enforce the plans when once they have been made. Time does not permit our retracing the argument to-day; suffice it that it has strong presumptive validity. As has already been noted, an increased complexity of function is being imparted to our social, industrial and political life by a growing technology; this demands a wider variety of specialized trainings and skills, and also calls for closer coordination between these specialized groups to the end that more rigidly guided and more narrowly confined spheres of action are imposed upon the individual. Since increasing emphasis upon specialization connotes planning while the increased need of guidance suggests dictatorship, we see that the two conditions are likely to merge *unless* great care is exercised to hold them apart.

Much depends upon that word "unless." What procedures are at once compatible with preservation of the individual's freedom of action and yet with the need of circumscribing and directing his activities? There seems to be but one single practicable possibility, that of voluntary and educated guidance imposed by the individual himself, and consonant with enlightened public opinion. In other words, we can but base our policy upon the old political axiom that the source of all liberty is enlightened self-restraint. Before this audience it is not necessary to contrast the casual, not to say misinformed, methods frequently employed by representative governments in transacting their business, with the painstaking studies which underlie most operations of private business. Present-day evidence of faulty stewardship by representative government is swelling to such a volume that we are in some danger of being confused and misled by its very bulk. Haphazard political methods must go. The operation of government on the basis of uninformed popular hunch and whim, coupled with political self-interest, can only end in absurdity, if not in disaster.

WIDER KNOWLEDGE DEMANDED

We are now at a stage where we possess "a little knowledge"—and are finding that it displays a peculiarly dangerous aspect. However, we will see clearly as we proceed that henceforth we must put our faith in the persistent and effective pursuit of broader knowledge, and at the same time give increased attention to its popular interpretation. This second point is as important as the first. Knowledge in the possession of a few who are without authority is powerless and useless, while knowledge in the possession of a few with authority to employ it is likely to be indistinguishable from totalitarianism. Final authority must be vested in the people if they are to retain their sovereignty, and understanding must be theirs too if the authority resting in them is to be used intelligently. Any other arrangement leads to concentrated control, since absence of control and likewise unwise control, under modern circumstances, are self-defeating alternatives.

Augmented knowledge seems, therefore, to be the sole key to liberalism's dilemma. The time has passed when, either in war or in peace, random and uninformed decisions in matters which at all vitally affect the body politic can be tolerated. Hence, what is now urgently needed is a new instrument of inquiry and investigation by which representative government, even in the face of novel circumstances, can educate itself "to act with vigor and economy," a phrase which you will recognize as borrowed from Henry Adams. It is his definition of an educated man, and it suggests precisely the status to which we must publicly attain.

In the search for an agency to be employed in the more effective pursuit of knowledge, we believe technology can offer a promising but as yet not widely recognized pattern.

It comes about in this way. To an increasing extent the larger problems of technology have become so involved that no single mind can cope with them adequately. As a concrete illustration—and no apology is made for the fact that it happens to be one with which the authors are especially acquainted—consider the dial telephone system as it now operates in a large metropolitan area. To any one at all familiar with the multitude of relays and opening and closing contacts, which must function to handle a single telephone call, the opinion will come as no surprise that it is one of the most complicated mechanisms yet devised. To comprehend it in all its ramifications, let alone to have developed, designed and built it, is a task probably beyond the capabilities of any single mind. Certainly, if its development and fabrication had waited upon the discovery of a sufficiently gifted individual who could have carried out the work himself, we might not have seen its completion for many a generation.

As an example the dial telephone serves our present purpose very well, but bear in mind that it is no more than typical. The importance of the illustration lies in the fact that instead of being content with the sort of undertakings that the individual human mind could handle, science (at least as concerns many departments) has forged ahead in the domain of organization and has succeeded in creating a sort of super-being which is vastly more effective than the unit individual. Each modern, large industrial research laboratory, such as characterizes the electrical and chemical industries, is an instance of such a super-being. It is scarcely necessary to analyze the situation in detail. The basic fact is that more and more, due to his inherent limitations, the lone worker is being replaced by a carefully chosen corps whose various talents dovetail together and whose collective knowledge and collective analytical powers greatly exceed those of any single member of the group. When working as a unit, the capabilities of such a group, measured by results, are likely to exceed by a considerable margin the sum of any individual achievements possible to its members. In essence of course it is simply the division of labor applied in the intellectual field.

To make this fact a little more evident it might be mentioned that the laboratory with which the authors are associated comprises about 4,500 employees, one half of whom are skilled scientists and technicians, while the remainder include very essential laboratory assistants and service groups. Experience speaks so strongly that to-day no verbal argument is needed to justify the existence of such a centralized research and development organization. No single individual, nor indeed a widely scattered but equal number of individuals, could hope to match the analytical and creative powers which such a laboratory, long accustomed to mutual effort, can focus upon its chosen field.

THE GERMAN METHOD

Thus the physical sciences display a prototype of the exploratory organization with which it ought to be possible to attack our larger social, economic and political problems such as give evidence of having outgrown the reach of former methods of solution. Moreover, at least one illustration may be cited that the method of the industrial laboratory is already proving effective when thus transplanted. It should come to no one as a surprise that Germany under Hitler has become none other than a vast laboratory dedicated to the perfection of the arts of war. It is not necessary to hypothesize any unusual skill at organization to explain the startling character of recent Nazi military achievements. The answer lies in the simple fact that the present German technique applies systematically and energetically to the affairs of a nation at war the precise methods which have characterized much of American industry for a generation or more.

It is well to recognize the type of human machine against which at any moment we may be pitted; we have here unimpugnable evidence that to wage a modern war successfully, and against a nation which has purposely set itself up as a war machine, involves detailed cooperation among all of a nation's population groups. Such a war machine may not actually rank in mechanical complexity with the dial telephone exchange, but it is clearly one of the more involved creations of modern science and industry. If a potential enemy, under dictatorship, chooses to focus all his powers upon its operation and coordinate its functioning by the same carefully drawn schedules that characterize industry, he leaves little choice but for other nations to adopt the same concerted methods as himself.

We are now witnessing a contest of strength between types of organization. In war the totalitarian state is proving itself a most potent adversary. It may in fact go further and succeed in proving also to have great survival power following war, unless perchance experience ultimately reveals that there is no branch of the human race—not even the Teutonic—so constituted as to submit indefinitely to the degree of dictation and regimentation that totalitarianism involves. Much as one might wish otherwise, there is little comforting evidence that a population working under the duress of dictatorship will lose significantly in efficiency. Certainly if any people were ever bludgeoned into submissiveness it has been the Germans under Nazi rule—in spite of which they continue to carry out orders of state with notable efficiency. It remains of course for the future to reveal whether such will be the case in peace as well as in war. If it should, then a new world situation indeed has been created.

DIFFICULT PROBLEMS OF PEACE

There are other reasons, however, and equally cogent ones, for believing that the time has come when a nation must institute a mass intellectual attack upon its social and political problems. For instance, was it not recent ways of peace which led to the present war? In other words, has the world yet learned to live at peace? Here it is that problems will arise whose calibre probably exceeds those presented by war, problems far exceeding the grasp of our present political methods of solution. Such problems become more and more the substratum of our daily lives in proportion as we base our livelihood upon the closely interrelated routine demanded by efficient operation of an industrial society. But the future prospect is certainly not one of unmitigated difficulty. Wise decisions and enlightened programs tend to induce a simplification of the political future. It is unwise and misguided national actions which lead us into political crises and morasses. Nevertheless, in the face of our growing involvement in the results of our own creative activity in the technological field, it behooves us to undertake a purposive improvement of those organizational forms which promise to be most effective knowledge-getters. Outstanding among these is the large research institution which assembles, in intimate association, a considerable number of experts whose professional knowledge and skills merge in harmonious cooperation.

It will already have occurred to the reader that the analogy between the manner in which a modern corporation employs its laboratory and the manner in which an equally modern state might employ a similar investigative and advisory body, is startlingly close. Therefore the argument will not now be labored. The only outstanding difference, and it is one which would not appear to be significant, is that in the case of the state with representative government the public is served by a corporation around whose board it occupies all the directors' seats. This is precisely the allocation of powers and duties which is contemplated in the formula, "Government of the people, by the people and for the people." Whatever advisory and investigative bodies the management of the state—that is, government—is authorized to create, the public as its own board of directors will be in possession of the findings of such bodies and, moreover, can demand that its chosen representatives properly employ them in their acts and policies.

LACK OF LABORATORY CONTROL

In advocating that for the more effective pursuit of the knowledge which efficient public management presupposes, the industrial laboratory offers an admirable starting point, certain fundamental difficulties should not be overlooked. Thus, the methods of attack in regard to problems of state must differ in certain regards from those employed in technology. As is universally recognized, the basis of the experimental method in science is deliberate control of the factors and parameters which enter any problem. This is quite possible when dealing with the inanimate, but by and large there will be scant opportunity for the employment of such arbitrariness when studying the questions involving animate creations. This limitation assuredly makes the approach more difficult but does not rule out the attractiveness of the mass attack; if anything, it makes it more imperative.

And by the same token we must not be discouraged by the observation that while the problems of technology are in considerable measure quantitative and therefore susceptible of being stated in concrete and uncontrovertible terms, the problems of government, in proportion as they are difficult, defy reduction to simple methods of measurement. Here again as the challenge mounts, the need of organized study and analysis surely increases. Moreover the quantitative character of industrial problems is frequently more apparent than real.

In the social sciences, as in industry, there would be need to reduce findings to terms suited to general consumption. One of the commonest charges against the scientist is that while he may be very successful in discovering new facts, he is likely to fail or be indifferent to the description of them in terms which the so-called popular audience can comprehend. Whether the fundamental scientist who is primarily engaged in charting unexplored territory is justified in more or less disregarding the charge—and doubtless most would agree that in large measures he does disregard it—the problem is one which the successful industrial laboratory can not set aside. Its principal duty, in fact, is so to interpret its findings and conclusions that management, who while highly skilled in many essential ways is not likely to be skilled in scientific principles and terminologies, can make its decisions intelligently in so far as they ought to take the work of the laboratory into account.

And, finally, an additional comment will help to clarify the discussion. It resolves itself in brief into the question of who gives the orders in industry, management or the laboratory. It is obvious that in all matters primarily technological the laboratory is, or ought to be, supreme. Its purpose is clearly not to attempt to carry out the whims of management; its duty and prerogative are to develop and urge new instrumentalities and, in its expert capacities, to advise management as to what projects may be embarked upon with reasonable assurances of technological success. In a very real sense, therefore, orders go from the laboratory up to management. Nevertheless, the duties and responsibilities of management remain clearly defined. In the last analysis all decisions are within its province and are its proper function. Aside from the aspects of the business which the work of the laboratory does not touch, it is the duty of management to decide what products of research shall be introduced into circulation, and when, as well as what, in general, the future projects of the laboratory shall be. But in many such matters a management that is well advised will earnestly solicit the full cooperation of the laboratory before pronouncing final judgment.

EXISTING POLITICAL ANALOGIES

Summing this up very briefly, the plan under which industry operates is seen to epitomize much of the republican form of government that our founding fathers intentionally created for the United States as a whole.

And in this connection it is well to bear in mind that there has been much loose talk in recent years regarding the identity of republican and democratic forms of government. Such is far from the truth. A republic is characterized by elected representatives who act in accordance with their own best judgment; in a pure democracy, each question is settled in accordance with the will of the majority. The former has proved workable and most of us devoutly hope that it will preserve this merit; the latter has never been workable, and there is less chance for it in the future than there ever has been in the past. The distinction between a republic and a democracy is one which the fathers of our Constitution had very clearly in mind; to quote one of them, James Madison, in the Federalist papers—"Democracies have ever been spectacles of turbulence and contention and have ever been found incompatible with personal security and the right of property, and have in general been as short in their lives as they have been violent in their deaths."

Without entering upon a discussion of the relative practical merits of a republic versus a democracy, it is nevertheless reassuring in view of Madison's observation, that the suggested use by government of organizations of technical experts whose existence is a continuing one and whose function is advisory to the elected representatives of the people is in every respect a republican institution. The proposal does not imply that the people as a whole must weigh detailed and involved evidence. It asks only recognition of the fact that over the years public respect for informed opinion has developed surprisingly, and hence will probably continue to rise. This in itself is a singularly notable phenomenon. No longer is the expert, and particularly the expert in science, the object of disdain or suspicion. Rather he is the medicine man of the present epoch and his word is usually accepted as authoritative. In other words the pragmatic success to which science and organized knowledge have attained has established a tradition that what counts in the world to-day is accuracy and truth, not guessing. This represents progress of the highest order. It means that the public mind is ready to accept a wider application of the scientific method—or the nearest approach to this method which is practicable in the affairs of state—and would bestow upon the information and conclusions thus provided the same high regard that it metes out to the more ordinary applications of logical investigation. In a word, that all-important person, the man-in-the-street, has become intuitively aware of a golden truth attributed to Marcus Aurelius, namely "To change thy mind and follow him who sets thee right is to be, nonetheless, the free agent that thou wast before."

However, it should be emphasized that there is still much room for progress in this respect. The many methods of inculcating a popular understanding and respect for the value of unbiased inquiry should receive even more earnest support than heretofore, and doubtless outstanding among these are the science columns of the daily press, the popular science journals and the science museums.

THE MACHINERY FOR POLITICAL INVESTIGATION

It is not the present intention—nor indeed would space permit—to venture any detailed suggestion as to the various organizational mechanisms which might be set up to procure the knowledge which must be procured if the liberal form of government is to maintain its workability. At the same time nothing said here is intended to imply that the practical problem which must be solved is anything short of extremely difficult. Its solution will quite obviously call for a very high order of statesmanship and political invention.

Let us note, however, that suggestive models and experience are already available. As regards certain fields of science, routines are now in existence whereby an independent and highly competent group of experts may render advice to the Federal Government. These routines had their origin in problems arising during the Civil War, and with certain additions the routines have remained in effect. The body of talent which is on call for consultation is the membership of the National Academy of Sciences or such other experts as the Academy may choose to select. During 1917 the pressure of war work became such that need of closer advisory routines led to the creation of the National Research Council, a body subsidiary to the National Academy and one which has had a continuing existence. Finally, as a result of the present crisis, the machinery of cooperation between the Federal Government and the nation's scientists has been further enlarged by an Executive Order creating the National Defense Research Committee. It is interesting, but perhaps not overly significant, that it has been war or the threat of war which has led to the creation and the elaboration of this machinery as well as to the periods of its extensive use.

In conclusion, it seems likely that we are well launched upon an era during which all the existing advisory aids to the government, as well as others still to be created, will have to function with increasing vigor. Such an arrangement need not savor of bureaucracy. The sovereign people will still remain sovereign. But belated and constructive recognition will have been given to the fact, now abundantly clear, that the day is gone, and probably forever, when a successful state can base its policies upon clamor of pressure groups or upon the uninformed beliefs of the majority, even though measured numerically by tens of millions.

OBITUARY

FRANCIS HOBART HERRICK[1]

Francis Hobart Herrick was born in Woodstock, Vermont, November 19, 1858, the son of the Reverend Marcellus Aurelius and Hannah Andrews (Putnam) Herrick. He attended St. Paul's School at Concord, New Hampshire, was graduated from Dartmouth College in 1881, earned the degree of doctor of philosophy at the Johns Hopkins University in 1888, and received the honorary degree of doctor of science from Western University of Pennsylvania in 1897 and from Western Reserve University in 1936. Immediately after having received his doctorate at the Johns Hopkins University he came to Western Reserve University as instructor in biology, to found what has since become a great university department of biology, including zoology, physiology and botany with their allied specialties. In 1891 he was appointed professor, and assumed permanent directorship of the laboratory. He retired from active service in 1929, becoming professor emeritus.

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[1] From a tribute at memorial services in Amasa Stone Chapel, Western Reserve University, September 14, 1940.

Professor Herrick was a fellow of the American Association for the Advancement of Science and of the American Ornithologists' Union; he was an associate of the American Museum of Natural History; he held memberships in the American Society of Naturalists, the American Society of Zoologists, the Boston Society of Natural History and the Wilson Ornithological Club; he was a founder, trustee and vice-president of the Cleveland Museum of Natural History.

His bibliography, published in 1938, includes approximately 130 titles, beginning in 1883 with his "Prairie Warbler in New Hampshire" and closing in October, 1937, with two articles on Audubon. This covers an active productive period of fifty-four years. Professor Herrick's intimate associate, Professor Visscher, calls my attention to the fact that this entire period falls roughly into three epochs so far as specialized interest is concerned. The first, devoted to the development and morphology of crustacea, comprises his important publications on the American lobster; the second may be called the Audubon period, in which was produced his definitive biography of Audubon; the third and final period was devoted to a study of the American eagle, which in many ways epitomizes his life-long work on the habits, the origins and the development of instincts of wild birds.

Such are the brief but pregnant annals of his rich life. They give but an imperfect picture of the teacher, the scientist, the cultured gentleman, the friend whom we knew and loved.

Immediately upon his coming to Western Reserve University certain traits and ideals became instantly apparent, of which evidence is seen again and again in his writings, in his addresses and in what we remember of his conversations. I refer particularly to his insistence upon the educational principle that the way to know nature is to observe her face to face, to his appreciation of knowledge of nature as an important cultural element in the life of our great city as evidenced by his early proposals in 1890 for the establishment of a museum of natural history, to his interest in art and his own fine performances in line and color as shown for example in his classic volume on the American lobster, to the high quality of his literary expression, as evidenced particularly, I think, in his life of Audubon, to his sense of humor and his kindness of heart, to his love of animals (Can we ever forget his favorite dog, Douglas?), to his ceaseless urge to intellectual activity, and to the breadth of his reading and the philosophical depth of his thinking.

In his foreword to Howard Corning's edition of "The Journal of John James Audubon, 1840–1843," he emphasized in Audubon what he himself exemplified, namely, "his indefatigable industry, his singleness of purpose and his kindness of heart."

And so finally, using words with which he closed his account of the life of Audubon: On the eleventh of September, 1940, Francis Hobart Herrick died "as gently as a child composing himself for his beautiful sleep."

WINFRED GEORGE LEUTNER

MARY VAUX WALCOTT

MARY VAUX WALCOTT (Mrs. Charles D. Walcott) died in her sleep on August 22 at the home of her dear friends, the Henry Phipps Rosses, at St. Andrews, Canada. She had just passed her eightieth birthday, when a warning heart attack made her realize her long life of activity and independence was closing down.

She was an extraordinary woman. In early years she was a well-known glaciologist, studying the recedence of glaciers on the North American continent. She was the first woman to climb Mt. Stephen in the Canadian Rockies and did so much toward the development of that beautiful country that a mountain was named for her, Mount Mary Vaux. She was director of many charities in Philadelphia, with a full and active life of varied interests, including a successful dairy farm, when, at the age of fifty-six, she married Dr. Walcott.

Then followed thirteen years of perfect companionship in a life of different activities, of wide social contacts, of scientific interests. Dr. Walcott encouraged her to continue her hobby of painting wild flowers and finally to publish the beautiful books of North American Wild Flowers, which will always be a lasting memorial to her name.

The friends she made, the associations she formed during those years were continued and added to, after Dr. Walcott's death.

Instead of a lonely widow marking time, she pushed ahead her forceful life of usefulness and accomplishment. Her church, the Society of Friends, had no adequate meeting house in the nation's capital. The newly elected President, Herbert Hoover, was a Friend. So she decided to have a Meeting House built in Washington. She raised the money, bought the land, and built the beautiful building that will always stand as a symbol of the quality and character of the Quakers.

Mary Walcott had the simplicity and naiveté of a child, with the business astuteness and driving force of a master of men. Entirely self-reliant, she drew people to her by the force of her independence and character. She helped, materially and inspirationally, all she came in contact with who needed help, and the love and tributes from her many friends were always a source of wonder to her.

A completely rounded life was hers—full eighty years of leading toward that goal of Christian civilization that in the course of history, in spite of the setbacks of wars and periodic decadence, makes man go forward.

H. W. Y.

SCIENTIFIC EVENTS

CHANGES IN MEDICAL PRESCRIBING IN GREAT BRITAIN

A correspondent of the London *Times* states that important changes in medical prescribing in Great Britain are recommended by an official medical committee composed of eminent members of the profession. The object of the recommendations is to support the government policy of avoiding the use of foreign currency, and also cargo space to bring to this country materials which are not sufficiently necessary to justify importation in war-time.

After surveying the drugs commonly used in medical practice, the committee has compiled a list of those which it considers are not essential. The attention of general practitioners, the pharmaceutical departments of hospitals and manufacturers of chemical preparations and proprietary articles is to be drawn to this list, with the recommendation that the drugs specified shall be prescribed and used sparingly.

Many of the items in the list of some seventy drugs are in frequent use, among them being the following: aconite, from Germany, Switzerland and France; balsam of tolu, from Colombia (South America); buchu leaves, from South Africa; agar, from Japan; calumba root and strophanthus seed, from Mozambique; cantharides, from U.S.S.R., Spain, Hungary and China; black catechu, from North Borneo; balsam cophiba, from northern South America; coriander seed, from Morocco, U.S.S.R. and Central Europe; cassia bark, from China; gelsemium root, from U.S.A.; gentian root, from France, Italy, Germany and Spain; witch hazel bark and leaves, from U.S.A.; jalap, from Mexico; krameria, from Peru; lobelia herb, from eastern U.S.A.; camphor oil, from Japan; psyllium seed, from Mediterranean countries; seneca root, from U.S.A., and tamarinds, from the West Indies.

The committee suggests substitutes which may be used in place of the drugs which it is undesirable to import in war-time. Adequate supplies of the substitutes are available, and in the opinion of the committee they possess therapeutic properties similar to the drugs which they will replace.

MEETING OF THE INDUSTRIAL RESEARCH INSTITUTE

The Industrial Research Institute, Chicago, met on September 27 and 28, at Swampscott, Mass. Problems of industrial research management and of the design of research laboratories were discussed by some fifty active executives in this field. Following the meeting it was announced that an inventory would be made by member companies of the special facilities and key personnel of their research organizations in the interests of the national defense program. Nathaniel McL. Sage, director of the Division of Industrial Cooperation, Massachusetts Institute of Technology, was guest speaker at a dinner tendered the members of the institute and their guests by the United Shoe Machinery Corporation following inspection of the company's new research laboratory at Beverly, Mass. Mr. Sage discussed the administrative problems of educational institutions in the present defense emergency.

The Industrial Research Institute, an affiliate of the National Research Council, was organized several years ago for the purpose of improving efficiency and effectiveness in the management of industrial research, through cooperation of its members. The membership is composed of industrial concerns maintaining research laboratories as a part of their organizations. The executives in charge of research of the member-companies represent them in the activities of the institute.

The general meeting was preceded by a session of the Institute's Executive Committee on September 26. H. Earl Hoover, vice-president of the Hoover Company, Chicago, is chairman and presided. Other members of the committee attending were:

L. W. Wallace, director of engineering and research, Crane Company, Chicago, vice-chairman of the institute; H. W. Graham, director of metallurgy and research, Jones and Laughlin Steel Corporation, Pittsburgh, past-chairman of the institute; R. B. Colgate, director, Colgate-Palmolive-Peet Company, past-chairman of the institute, Jersey City; F. W. Blair, chemical director, Procter and Gamble Company, Ivorydale, Ohio; R. C. Newton, chief chemist, Swift and Company, Chicago; Maurice Holland, director, Division of Engineering and Industrial Research, National Research Council, New York, and Caryl P. Haskins, president, The Haskins Laboratories, New York.

At the business session the members voted to cooperate in a survey of special facilities and key personnel of their respective research organizations in the interest of the national defense program. Dr. Caryl P. Haskins was elected a member of the executive committee. Announcement was also made of the election of Alexander Smith and Sons Carpet Company, Yonkers, N. Y., to membership in the institute, with A. G. Ashcroft, director of research, as its representative. It was also announced that the office of the secretary was being moved from New York to 8 South Michigan Avenue, Chicago, in order to be near that of the chairman, H. Earl Hoover, vice-president, The Hoover Company. Dr. Maurice Holland, director of the Division of Engineering and Industrial Research of the National Research Council, will continue to represent the institute at its New York office.

"UNLIMITED HORIZONS," A WEEKLY BROADCAST

"UNLIMITED HORIZONS," a new weekly broadcast series devoted to the physical sciences, will be heard over the Blue Network of the National Broadcasting Company beginning on Friday, November 1, at 11:30 P.M., Eastern Standard Time. The series will be presented in cooperation with the University of California, Stanford University and the California Institute of Technology.

The first program, "Science—Bane or Blessing?" will be a round-table discussion on science and its influence on society. Dr. Robert Gordon Sproul, Dr. Ray Lyman Wilbur and Dr. Robert A. Millikan, presidents of the three cooperating universities, will be the participants. The other broadcasts are:

November 8—"Heavenly Bodies"—Astronomy, featuring contribution to this science by the California Institute of Technology. Dr. J. A. Anderson, Dr. Edwin Hubble.

November 15—"The Klystron and Radio Beams"—The story of Stanford University Department of Physics' development of a new radio tube which has been a boon to the aviation industry. Professor David L. Webster, Professor William W. Hansen, Sigurd Varian and Russell H. Varian, research associates.

November 22—"Unearthing the Past"—Story of paleontology by the University of California. Description of prehistoric life. Short-wave pick-up from diggings in the slopes of Mount Diablo. Dr. Charles L. Camp and Professor Ralph W. Chaney.

November 29—"How to Cultivate Plants and Influence Growth." Department of Plant Nutrition at California Institute of Technology discusses Vitamin B—its discovery, development and present-day use. Dr. F. W. Went and Dr. James Bonner.

December 6—"Faults of the Earth"—Stanford's Department of Mechanical Engineering tells of earthquake research. Professor Lydik S. Jacobsen.

December 13—"The Science of Sound"—The Department of Physics of the University of California presents a discussion of the scientist's findings in the strange realm of sound. Dr. Vern O. Knudsen.

December 20—"Wings on Man"—Department of Aeronautics of Stanford and California Institute of Technology—meteorological development in relation to aviation. Professors Alfred S. Niles and Elliott G. Reid, of Stanford, and Dr. von Kármán, Professor Clark Millikan and Dr. Irving Krick, California Institute of Technology.

December 27—"Salmon Savers"—Stanford School of Biology tells of early work in conservation of salmon on Pacific Coast, and recent developments in the modern salmon pack. Professors Paul J. Beard and Willis H. Rich.

January 3—"Building by Breaking"—A description of the giant universal testing machine, which exerts a tension of three million pounds and compression of four million pounds, from College of Engineering, University of California. Dr. Raymond E. Davis.

January 10—"Cosmic Rays—What Next?"—Department of Physics, California Institute of Technology, discusses Dr. Robert A. Millikan's work on cosmic rays and the results of his recent trip to India in the study of this phenomenon. Dr. Robert A. Millikan.

January 17—"Millions to Burn"—From Ryan Laboratory of Stanford University Department of Electrical Engineering. A discussion of modern experiments in transmitting high voltage over long distances. Professors Fred E. Terman, Joseph S. Carroll and William G. Hoover.

January 24—"The Cyclotron and the Atom"—The world's greatest atom-smasher. From the Radiation Laboratory of the University of California, a description is given of the giant 225-ton cyclotron, now in full research program. Interviews with Dr. E. O. Lawrence, inventor; Dr. Donald Cooksey and staff associates.

ELECTION OF OFFICERS OF THE AMERICAN CHEMICAL SOCIETY

THE election of seventy-two chemists to administrative and editorial posts in the American Chemical Society has been announced by Dr. Charles L. Parsons, secretary of the society. Officers were chosen by seventeen of the professional divisions, as well as by the local section officers' group and the divisional officers' group. Editors and associate editors of five scientific publications were named, and a member of the Council Policy Committee was reelected.

Changes have been made in the names of two divisions. The Division of Microchemistry becomes the Division of Analytical and Micro Chemistry, and the Division of Paint and Varnish Chemistry will henceforth be known as the Division of Paint, Varnish and Plastics Chemistry.

The society, which now has approximately 25,300 members, has undertaken, as already reported in SCIENCE, a census of all chemists and their experience in the interest of national defense. Nearly 3,000 new members have been elected to the society during 1940.

Establishment of a new local section with headquarters in Cumberland, Md., and territory comprising Allegany, Garrett and Washington Counties in Maryland, to be known as the Western Maryland Section, has been authorized. Ninety-two other local sections are located throughout the country. The next semi-annual meeting will be held next April in St. Louis, Mo.

The new divisional officers are:

Division of Agricultural and Food Chemistry: Chairman, Gerald A. Fitzgerald, of the General Foods Corporation, New York City; *Vice-chairman*, Ellery H. Harvey, of Highland Park, Ill.; *Secretary-treasurer*, Professor Carl R. Fellers, of Massachusetts State Agricultural College.

Division of Analytical and Micro Chemistry: Chairman, Dr. G. E. F. Lundell, of the U. S. Bureau of Standards; *Vice-chairman*, George L. Royer, of the American Cyanamid Company, Bound Brook, N. J.; *Secretary-treasurer*, the Reverend Francis W. Power, of Fordham University.

Division of Biological Chemistry: Chairman, Dr. Herbert O. Calvery, of the U. S. Department of Agriculture; *Secretary*, Professor Erwin Brand, of the Columbia University School of Medicine.

Division of Cellulose Chemistry: Chairman, Dr. William O. Kenyon, of the Eastman Kodak Company, Rochester, N. Y.; *Vice-chairman*, Dr. Elwin E. Harris, of the Forest Products Laboratory, Madison, Wis.; *Secretary-treasurer*, Dr. Charles R. Fordyce, of the Eastman Kodak Company.

Division of Chemical Education: Chairman, Professor Rufus D. Reed, of New Jersey State Teachers College, Montclair; *Vice-chairman*, Nicholas D. Cheronis, of the Chicago City College, Chicago; *Secretary*, Professor Paul H. Fall, of Hiram College, Ohio; *Treasurer*, Professor Virginia Bartow, of the University of Illinois.

Division of Colloid Chemistry: Chairman, Professor Arthur M. Buswell, of the University of Illinois; *Vice-chairman*, Frederich Olsen, of the Western Cartridge Company, East Alton, Ill.; *Secretary-treasurer*, Dr. W. O. Milligan, of the Rice Institute, Houston, Texas.

Division of Fertilizer Chemistry: Chairman, Dr. H. B. Siems, of Swift and Company, Chicago; *Secretary*, Charles A. Butt, of the International Agricultural Corporation, East Point, Ga.

Division of the History of Chemistry: Chairman, James F. Couch, of the U. S. Bureau of Agricultural Chemistry and Engineering, Philadelphia; *Secretary-treasurer*, Professor Ralph E. Oesper, of the University of Cincinnati.

Division of Industrial and Engineering Chemistry: Chairman, Professor Barnett F. Dodge, of Yale University; *Vice-chairman*, Walter A. Schmidt, president of the Western Precipitation Company, Los Angeles; *Secretary*, Whitney Weinrich, of the Gulf Research and Development Company, Pittsburgh.

Division of Medicinal Chemistry: Chairman, Dr. Russell J. Fosbinder, vice-president of the Maltbie Chemical Company, Newark, N. J.; *Vice-chairman*, Professor John H. Gardner, of Washington University, St. Louis; *Secretary-treasurer*, Dr. John H. Speer, of G. D. Searle and Company, Chicago.

Division of Organic Chemistry: Chairman, Professor Nathan L. Drake, of the University of Maryland; *Secretary-treasurer*, Professor Arthur C. Cope, of Bryn Mawr College.

Division of Paint, Varnish and Plastics Chemistry: Chairman, G. G. Sward, of the National Paint, Varnish and Lacquer Association, Washington, D. C.; *Chairman-elect*, Shailer L. Bass, of the Dow Chemical Company, Midland, Mich.; *Secretary-treasurer*, Adolf C. Elm, of the New Jersey Zinc Company, Palmerton, Pa.

Division of Petroleum Chemistry: Chairman, J. K. Roberts, of the Standard Oil Company of Indiana, Chicago; *Vice-chairman*, Professor M. R. Fenske, of Pennsylvania State College; *Secretary-treasurer*, Dr. Cary R. Wagner, of the Pure Oil Company, Chicago.

Division of Physical and Inorganic Chemistry: Chairman, Professor John G. Kirkwood, of Cornell University; *Chairman-elect*, Professor W. Conard Fernelius, of the Ohio State University; *Secretary-treasurer*, Dr. Ralph E. Gibson, of the Geophysical Laboratory, Washington, D. C.

Division of Rubber Chemistry: Chairman, Roscoe H. Gerke, of the United States Rubber Company, Passaic, N. J.; *Vice-chairman*, John N. Street, of the Firestone Tire and Rubber Company, Akron, Ohio; *Secretary*, Professor Howard I. Cramer, of the University of Akron; *Treasurer*, C. W. Christensen, of the Rubber Service Laboratories Company, Akron.

Division of Sugar Chemistry and Technology: Chairman, R. Max Goepp, Jr., of the Atlas Powder Company, Wilmington, Del.; *Vice-chairman*, Sidney M. Cantor, of the Corn Products Refining Company, Argo, Ill.; *Secretary-treasurer*, B. Whitman Rice, of the National Sugar Refining Company, New York City.

Division of Water, Sewage and Sanitation Chemistry: Chairman, Professor Charles R. Hoover, of Wesleyan University; *Vice-chairman*, Louis F. Warrick, of the Wisconsin State Board of Health; *Secretary-treasurer*, Professor Frederick G. Straub, of the University of Illinois.

The Division Group Officers have reelected Professor Cliff S. Hamilton of the University of Nebraska as chairman, and Professor Buswell as secretary.

Dr. Jacque C. Morrell, associate director of the Universal Oil Products Company, Chicago, has been chosen chairman of the Local Section Group Officers; Dr. F. O. Rice, of the Catholic University of America, is chairman-elect, and Auburn A. Ross of Eli Lilly and Company, Indianapolis, Ind., secretary.

Two associate editors of the *Journal of the American Chemical Society* were elected for five-year terms as follows: Professor Werner E. Bachmann, of the University of Michigan; Professor Henry Gilman, of the Iowa State College. Associate editors of the *Journal of Physical Chemistry* for a term of two years are Professors W. H. Rodebush, of the University of Illinois, and I. M. Kolthoff, of the University of Minnesota.

Professors L. O. Brockway, of the University of Michigan, and C. G. King, of the University of Pittsburgh, will be associate editors of *Chemical Reviews* for a term of three years. Dr. William A. Noyes, of the University of Illinois, was reelected editor of the scientific monographs for three years. The following associate editors were named: Dr. William Mansfield Clark, of the Johns Hopkins University; Dr. Louis F. Fieser, of Harvard University; Dr. Samuel C. Lind, of the University of Minnesota, president of the society; Dr. Linus Pauling, of the California Institute of Technology.

Dr. Harrison E. Howe, of Washington, D. C., continues as editor of "Technological Monographs" for three years. Associate editors will include Dr. C. H. Mathewson, of Yale University; Dr. W. G. Whitman, of the Massachusetts Institute of Technology, and Dr. F. W. Willard, of the Nassau Smelting and Refining Company, New York City.

Dr. Lundell and Professor H. H. Willard, of the University of Michigan, will serve on the advisory board of the analytical edition of "Industrial and Engineering Chemistry."

Dr. Gustavus J. Esselen, of Boston, was reelected to the Council Policy Committee for three years beginning on January 1, 1940.

SCIENTIFIC NOTES AND NEWS

Dr. E. B. Forbes, director of the Institute of Animal Nutrition at the Pennsylvania State College, has been elected a foreign member of the Royal Swedish Academy of Agriculture.

Dr. Edward W. Berry, professor of paleontology and provost of the Johns Hopkins University, has been elected a corresponding member of the Academia Nacional de Ciencias, Cordoba, Argentina.

The Sir Henry S. Wellcome Gold Medal for 1940 and a cash prize of $500 were presented to Captain Lucius W. Johnson, medical corps, U. S. Navy, by the Association of Military Surgeons at the annual meeting held at Cleveland on October 10, 11 and 12. The award was offered for essays on "Medical and Sanitary Care of the Civilian Population Necessitated by Attacks from Hostile Aircraft." Captain Johnson's paper will be published in *The Military Surgeon*.

The Paris Academy of Sciences has awarded the Montyon Prize to Dr. Constantin Levaditi, of the Institut Pasteur.

An international prize on the subject of encephalitis has been awarded by the University of Berne to Dr. Beppno Disertori, the Italian neurologist.

The American Society for the Control of Cancer and its Women's Field Army have cited the following American women "for their significant contributions to cancer control": Dr. Maynie R. Curtis and Dr. Wilhelmina F. Dunning, of the Crocker Laboratory for Cancer Research, Columbia University; Dr. Elsie L'Esperance, founder of the Strang Clinic of the New York Infirmary for Women and Children; Elizabeth Fekete, Jackson Memorial Laboratory, Bar Harbor; Dr. Clara J. Lynch, Rockefeller Institute for Medical Research; Dr. Catherine Marfarlane, of the Women's Medical College of Philadelphia; Mrs. Robert G. Mead, New York City Cancer Committee; Dr. Anna Palmer, founder of the Cured-of-Cancer Club; Dr. Edith Quimby, Memorial Hospital, New York City; Dr. Mildred W. S. Schram, International Cancer Research Foundation, Philadelphia, and Dr. Maude Slye, of the University of Chicago.

At the recent meeting in Cleveland of the American Congress of Physical Therapy, annual awards of merit were presented to Dr. Abraham R. Hollender, of Miami Beach, Fla.; Dr. George W. Crile, emeritus professor of clinical surgery of the Medical School of Western Reserve University; Dr. Disraeli W. Kobak, of Chicago; Dr. Malcolm T. MacEachern, of DePaul University; Dr. William F. Petersen, professor of pathology at the University of Illinois; Dr. Horatio B. Williams, Dalton professor of physiology and director of the department at Columbia University, and Dr. Charles F. Kettering, Dayton, Ohio, general manager of the research laboratories of the General Motors Corporation and founder of the Kettering Department of Medical Research at the Miami Valley Hospital, Dayton.

Guy Emerson, of New York City, has been elected president of the National Audubon Society (formerly the National Association of Audubon Societies). Dr. Robert Cushman Murphy, who had been president for three preceding terms and a director for twenty years, was elected honorary president.

Professor Arthur W. Hixson, professor of chemical engineering at Columbia University in charge of courses in process development and plant design, has been appointed head of the department of chemical engineering.

Dr. F. F. Lininger, head of the department of agricultural economics of the Pennsylvania State College and Agricultural Experiment Station, was recently appointed vice-dean of the School of Agriculture and vice-director of the station. Dr. M. A. Farrell, associate professor of bacteriology, has been named professor of bacteriology and head of the new department of bacteriology.

Dr. W. S. Gillam, assistant professor at Michigan State College, has been appointed assistant professor in agricultural chemistry at Purdue University to fill the vacancy arising through the resignation of Dr. Dale H. Sieling, who was recently appointed research professor in the department of chemistry of the Massachusetts State College.

The following changes at dental schools have been announced recently: At the University of Nebraska, Dr. Bert L. Hooper has replaced Dr. George A. Grubb. At the University of Illinois, Dr. F. B. Noyes has been succeeded by Dr. Howard M. Marjerison, previously dean of Tufts Dental College. The vacancy in the deanship at Tufts was filled by the appointment of Dr. Basil G. Bibby, of the School of Medicine and Dentistry of the University of Rochester. At the Ohio State University, Dr. H. M. Semans, one of the oldest dental deans from the point of period of service, has been succeeded by Dr. Wendell D. Postle. Dr. H. V. Cottrell, for many years secretary of the Dental College of the Ohio State University, has been succeeded by Dr. Paul C. Kitchin. Dr. Balint Orban, formerly of Vienna and recently with the Northwestern University Dental School, has been appointed a member of the staff of the Foundation for Dental Research of the Chicago College of Dental Surgery. Dr. Josef Weinmann, formerly of Columbia University, has also joined the staff.

Professor Hudson Hoagland, director of the physiological laboratories of Clark University, has leave of absence for the year 1940–41, which he will spend as research associate in physiology at the Harvard Medical School.

Dr. Eliot C. Williams, Jr., during the past year a university fellow at Northwestern University, has been appointed assistant to the director of the Chicago Academy of Sciences.

Dr. George M. Sutton, curator of birds at Cornell University, and Dr. O. S. Pettingill, instructor in zoology at Carleton College, plan to make an ornithological expedition into Mexico during the birds' breeding season from February to June, 1941. Headquarters will be at Rancho Rinconada, in southwestern Tamaulipas. It is also planned to work at San Luis Potosi, Vera Cruz and Hidalgo.

Professor Enrico Fermi will speak before members of the New York branch of the American Association of Scientific Workers and their guests at the Men's Faculty Club of Columbia University at 8:15 P.M. on November 1. His subject will be "Latest Research on Cosmic Rays." A dinner for members will be held at 6:30 P.M. at the Faculty Club.

Dr. W. M. Stanley, of the Rockefeller Institute for Medical Research, Princeton, N. J., gave during October a series of three lectures on viruses on the Hitchcock Foundation of the University of California at Berkeley.

Dr. Tenney L. Davis, professor of organic chemistry at the Massachusetts Institute of Technology, addressed the October meeting of the American Academy of Arts and Sciences on "The Identity of Chinese and European Alchemical Theory."

At the meeting of the Society of Medical History of Chicago on November 4, illustrated addresses will be given by Dr. Abraham Levinson on "Medical Medallions," by Dr. James E. Lebensohn on "Wollaston and Hemianopsia," and by Dr. Jerome Head on "Bretonneau, Trousseau and Velpeau."

Dr. Christian A. Ruckmick, secretary and general sales manager of the C. H. Stoelting Company, Chicago, gave an address on October 10 before the Industrial Management Society in Chicago, entitled "Scientific Advancement of Unskilled Employees to Skilled Occupations by Application of Practical Tests."

Professor L. C. Dunn, executive officer of the department of zoology at Columbia University, writes that it has been visited by thieves and the following optical equipment has been stolen: Spencer research microscope #112538, Cat. type 7-H with binocular body, 16 m/m objective #276803, 4 m/m objective #287632; 2 m/m oil immersion lens, Spencer #17763; binocular Spencer microscope #112846; binocular Spencer microscope #112535; monocular microscope Spencer #115601, and monocular microscope Spencer #115185. The department would be grateful for a report from any one who discovers any of these numbers in other laboratories.

The fortieth expedition of the department of tropical research of the New York Zoological Society under the directorship of Dr. William Beebe has returned from two months' field work at the society's laboratory at New Nonsuch, Bermuda. Among the staff were Miss Jocelyn Crane, Greame-Kelley and Bronson Hartley. Satisfactory progress was made in continued studies of the life histories of fish and crabs.

With the purpose of encouraging the publication of books and monographs of scientific importance by members of the Harvard Medical School and the Harvard School of Public Health, and of adding to the distinction both of the two schools and of the Harvard University Press by publishing under their auspices a noteworthy series of monographs in medicine and public health, a sum of money has been provided, to be used for an experimental period of three years, as a revolving publication fund. An editorial committee consisting of Dr. A. Baird Hastings, chairman, Dr.

Walter B. Cannon, Dr. James Howard Means, Dr. S. Burt Wolbach and Dr. Katherine R. Drinker, executive secretary, has been appointed to administer this fund and to select books and monographs to be included in a series entitled "Harvard University Monographs in Medicine and Public Health."

The American Dental Association this year appropriated $23,000 for investigation and research on dental problems. This is an increase of $6,000 over last year. Of this increase, $5,000 will go toward the establishment of a fellowship in dental research at the National Institute of Health.

The Hooker Scientific Library, conducted as a nonprofit institution by Central College, has inaugurated a new service for chemists who lack convenient access to chemical reference works. For a nominal fee the library will send data on any question which can be answered by reference to a chemical manual, dictionary or index. Inquiries taking too much time for the low fixed rate will be answered at a proportionately higher cost, for which estimates can be rendered in advance. Full details will be sent in response to requests addressed to Hooker Scientific Library, Central College, Fayette, Mo.

Sixty professional gardeners are registered this term in the two-year Science Course offered by the New York Botanical Garden. The first session was held on October 7 and the classes will continue through December 23. These are the largest classes in the history of this course, which was inaugurated in 1932. Dr. B. O. Dodge, plant pathologist, lectures on Plant Pests and Diseases, and Dr. F. W. Kavanagh on Soils and Fertilizers. In addition to the student gardeners at the Botanical Garden, the class includes employees of the New York City Park Department, professional gardeners who were registered last year in the practical course, and several employees of florists and nurserymen, as well as gardeners on estates in and around New York. Some of the students come more than sixty miles to the class each week. In the two-year course in practical gardening which meets every Thursday evening for a study of Cultivation of Trees and Shrubs under P. J. van Melle, of Poughkeepsie, there are about ninety students in attendance. They include a number of men and women aiming to develop their home grounds, professional gardeners desiring further instruction in their field, and teachers, lawyers, lecturers, executives and other business people.

DISCUSSION

SOME ADDITIONAL OBSERVATIONS ON SLUMPING AND GULLY FORMATION

Since slipping is important to the engineer, landscape architect and soil conservationist and since it may occur under somewhat different circumstances, we are recording some additional observations of this phenomenon which have occurred under different conditions than those previously recorded for the hillside in question.[1] The present observations are significant because a rain gauge located about 75 feet away from the slip makes it possible to obtain exact data relative to the rainfall conditions where slipping has occurred and because the conditions of cover have changed since slipping was last observed on the hillside.

During the night of October 6, 1936, a mass of 170 cubic feet of material slumped 3 feet down the west slope of what is known as Flag Pole Hill on the campus of Muskingum College in New Concord, Ohio. For a period of 12 hours, beginning in the afternoon of October 6, 1939, a rain gauge about one mile south of New Concord indicated that 4½ inches of rain had fallen, most of it—perhaps 3 inches—fell in the space of one hour. Considerable gullying occurred on the hillside during this period.

The slope was immediately graded and sown to grass and pine trees were planted below the slipped area up to the top of the clay upon which the slipping had occurred. Until recently no further slumping or gullying was noted.

Observation of this hill was again made on April 22, 1940, after a week of almost daily rainfall, during which time the rain gauge on top of the hill registered a total of 4.7 inches. At this time a roughly triangular-shaped area had slipped down the hill from 2 to 3 feet. The slip took place along three planes, one extending in a northwest-southeast direction for a distance of 30 feet, the southeast or uphill edge of which joined another slip plane extending for 10 feet in a north-south direction. This plane was joined at the south end by a plane extending southwest for a distance of 25 feet. From the south end of the north and south trending plane a smaller plane having a displacement of a few inches extended southward for a distance of 10 feet.

The material which had slipped down hill formed a roughly triangular terrace-like area 5 feet high and 30 feet across, tapering to the southeast and southwest for a distance of 20 feet. Several of the small pine trees, 3 or 4 feet in height, had been tilted and one had been pushed over and partly covered by the slipped material.

Several small terrace-like areas whose fronts were

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[1] Robert H. Mitchell, Science, 84: 2184, 420, November 6, 1936.

4 to 5 inches high occurred on the slope above the main terrace, suggesting multiple slipping. This idea is strengthened by the fact that a number of wrinkles resembling small overturned folds occurred on the surface of the large terrace.

Extending southward from the base of the main slip for a distance of 36 feet creep had occurred, forming a terrace whose front was 2 feet high and 6 feet wide. The uphill side of this creep was scarcely discernible except for the steepened slope, since the grass was not seriously disturbed. Gullying on the slope was negligible.

The slip took place on a clay layer about 11 feet above the horizon of the Harlem coal. The material above the clay became saturated with water after a week of almost daily rain. The rain gauge 75 feet above the slip showed the following rainfall record: April 11–12, 1.2; April 15, 0.5; April 16, 0.2; April 17–18, 0.7; April 19–20, 3.3.

When the area was previously studied in 1936 the hillside had just been graded and prepared for grass. No trees had been planted on the slope. At that time 4.5 inches of rain fell in less than 12 hours. The recently observed slip occurred at the same location and on the same clay layer, but after the hillside was well covered with grass and the lower slope planted to trees up to the clay layer and after 4.7 inches of rain had fallen during a week's time. At both times the same clay layer was responsible for the slip after about the same amount of rain had fallen.

The significant difference in conditions under which slumping took place in 1936 and recently lies in the fact that the slope in the first case had no cover of any sort, while in the recent case it was well covered with grass. Another notable difference was in the nature of the rainfall; in 1936 the rainfall was concentrated into a few hours, while in the recent situation about the same amount of rain fell but it was distributed over a period of one week.

Since the quantity of rainfall in both cases was similar we might conclude that slumping may take place in certain areas underlain by clay when a condition of sufficient saturation is reached, whether the slope is covered or not. It is also significant that gullying has been checked by a good cover of grass and trees. Grass and small trees, however, were not sufficient protection against slipping when the condition of saturation was reached. It, therefore, becomes apparent that in this and similar situations the engineer, landscape architect and soil conservationist can not depend on cover alone for protection from slipping.

The fold-like wrinkles which occur on the surface of the terrace formed of slipped material in several cases had become arcuate when they occur just above a tree. The convex side of the arc is on the uphill side away from the tree. This condition indicates that the trees had a tendency to hold the slip. Since some of the trees near the toe of the slip had been moved and one had been overturned it is doubtful that trees would have entirely prevented slipping, though had they extended above the slip area, it is possible that they would have modified the slip and permitted less movement.

Robert H. Mitchell

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MATING AND OVIPOSITION IN THE PACIFIC COAST TREE TOAD

In connection with studies on the biology of amphibia the writer has had opportunity to make certain observations on the mating behavior of the Pacific Coast tree toad (*Hyla regilla*). Since there is apparently no previous account of this in the literature, the following may be of interest.

The beginning of the breeding season of *Hyla regilla* is marked by the congregation of large numbers of vociferous males at transient rain pools and more permanent bodies of water. The female does not enter the water until ready to deposit the eggs; the entry is ordinarily made in late afternoon or early evening, and mating and egg laying completed by the following morning. Since the females enter singly or in small groups, the superior number of males makes probable an immediate mating. By continued observation of hylas collected in the San Francisco Bay region, the details of amplexus and oviposition in this species have been learned.

A preliminary period of clasping is usual before laying begins. In the laboratory this varies from 4 to 24 hours, while in nature it is probably not longer than 4 to 9 or 10 hours. The amplectic posture is of the pectoral type with the male dorsal to the female. The forelegs of the male, placed directly behind those of the female, strongly constrict her in that region. Ordinarily there is no contact between the bodies of the pair behind a point just posterior to the pectoral girdle of the male. The hind legs of the male are folded as if in a sitting position and usually do not touch the female except when directly employed.

Insemination occurs at the moment of egg extrusion. The male brings his cloacal aperture close to that of the female, discharges a quantity of transparent semen, and with a quick, firm extension slides his feet posteriorly over the sides and hips of the female, then deftly retracts to his normal position. Simultaneous with this foot action, the female extrudes a clutch of eggs into the cloud of sperm about her cloaca. Some time before releasing an egg mass the female often scratches at the surface of the substratum on which the eggs are to be deposited. As the eggs are extruded the cloaca is brought into close contact with this surface and attachment is thus effected. The female removes any eggs which may partially adhere to the cloaca during extrusion by a precise flexor-extension reflex of the hind legs. In this the tarsi are applied directly to the adhering eggs and a slow extension effects the removal.

Deposition of an egg mass is usually followed by a quiet moment during which the bodies of the pair become slightly more inflated than normally. The intervals between egg deposition, ranging from 2 to 10 minutes or longer, are spent in bursts of vigorous activity, mainly on the part of the female. What function this may serve, if any, is conjectural, but it apparently takes place under natural as well as artificial conditions. In the laboratory such periods are followed by a rest and then further oviposition. Shortly after laying is complete, the pair becomes separated. The entire time in amplexus has been observed to range from 8 to 40 hours or more.

The total number of eggs deposited was found to range from 500 to 750; however, Storer[1] reports an instance of 1,250 eggs being laid. The number of eggs per clutch is usually about 16, but varies from 5 to 60. Further, a tendency exists toward the close of the laying for the size of the clutch to taper off to 3 or 4 or even single eggs. There is indication that the embrace of the male may be requisite to the proper extrusion of eggs by the female. Three gravid females, isolated without mates, laid only 26, 92 and 80 eggs, respectively, on the evening following capture, and all three died during the ensuing day. The evidence at hand indicates that resorption of eggs does not occur in the gravid, unmated female. It would thus appear that retention of the eggs is fatal to the animal.

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[1] T. I. Storer, *Univ. Calif. Publ. Zool.*, 27: 225, 1925.

THE PROPOSED TERMS "EXERGONIC" AND "ENDERGONIC" FOR THERMODYNAMICS

The terms "exothermic" for reactions giving off heat and "endothermic" for those absorbing heat were coined in the last century when it was hoped that a concentrated attack on thermochemistry would solve the problems of chemical affinity and enable the chemist to predict the direction of spontaneous chemical reaction. This hope was illusory, but the nomenclature is quite useful and may also be applied to reactions for which the decrease in heat content $-\Delta H$ is positive or negative, respectively.

Those reactions do go spontaneously for which the entropy of the system and surroundings increases. This criterion of the second law of thermodynamics is rather general, and it has been found more convenient to particularize the law with reference to the free energy F and use the criterion that a reaction will go by itself if the free energy decrease $-\Delta F$ is positive at constant pressure and temperature, or in other words, if useful work (rather than heat) could be produced by a reversible mechanism. An interesting chemical analysis of the correlation of these two thermodynamic criteria has been given by T. W. Davis,[1] since the change in entropy ΔS is negative for many reactions for which $-\Delta F$ is positive and reaction occurs spontaneously. The importance of free energy in chemistry is so great that G. N. Lewis and M. Randall[2] included it in the name of their classical book that crystallized the course of research in chemical thermodynamics.

No terms have received wide acceptance which aptly characterize so-called spontaneous and nonspontaneous reactions. We therefore propose that the term "exergonic" be applied to reactions which can produce work, and "endergonic" be applied to those on which work must be expended to cause the reaction to occur. At constant pressure and temperature exergonic signifies $-\Delta F$ is positive, and endergonic signifies $-\Delta F$ is negative.

These two words are derived from the Greek *ergon*, work, and are etymologically analogous to the corresponding thermochemical terms derived from *thermē*, heat. The word *ergon* was formerly used as a synonym for the unit of work, the erg, and in a more restricted sense applies in physics to a unit of work measured in heat. This application of the cognate word is consistent with modern scientific usage to express free energy values and changes in calories.

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SAT-CHROMOSOMES

This technical term, introduced by Heitz,[1] is widely misunderstood and has been misused repeatedly in cytological literature. "SAT" is an abbreviation[2] of "Sine Acido Thymonucleinico." "SAT-Chromosome" is not a synonym for satellited-chromosome but signifies either a satellited chromosome or a chromosome with a secondary constriction that is associated with the formation of the nucleolus. All satellited chromosomes are SAT-chromosomes, of chromosomes with secondary constrictions, some are SAT-chromosomes,[3] some are not. The term "Nukleolenchromosom," perhaps best translated "nucleolar-chromosome," may be used as a synonym for "SAT-chromosome," although, as Heitz[2] points out, the two terms are supplementary rather than identical in meaning.

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[1] *Jour. Chem. Educ.*, 13: 376 (1936).

[2] "Thermodynamics and the Free Energy of Chemical Substances," McGraw-Hill Book Company, New York, 1923.

[1] E. Heitz, *Planta*, 12: 775–844. 1931.

[2] E. Heitz, *op. cit.*, p. 812.

[3] L. Geitler, "Chromosomenbau," Berlin, 1938, p. 24.

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SCIENTIFIC BOOKS

INFLAMMATION

Dynamics of Inflammation: An Inquiry into the Mechanism of Infectious Processes. By Valy Menkin. New York: The Macmillan Company, Experimental Biology Monographs. 1940.

As the title indicates, the book presents one aspect of the broad subjects of inflammation and infection. The author reviews the significant contributions he has made to knowledge of inflammation and correlates them with the observations of others. He has been chiefly concerned with the fixation of injurious agents at the site of inflammation, the influence of inflammation upon the invasion of bacteria and the relation of inflammation to immunity.

The introduction is a brief review of the history of knowledge concerning inflammation up to and including the contributions of Cohnheim and Metchnikoff. Conventional subjects of dispute among those who have been interested in inflammation are fortunately ignored. It is doubtful if the opinions of Virchow concerning inflammation have been wholly abandoned, as the author states, for some modern writers still include parenchymatous degeneration in the domain of inflammation and existing nomenclature of disease perpetuates his influence upon knowledge of the subject.

Inflammation is broadly defined by the author as the complex vascular lymphatic and local tissue reaction elicited in higher animals by the presence of microorganisms or of non-viable irritants. The difficulty of finding a satisfactory definition of inflammation has been very great, and it is probable that this, like many other definitions of inflammation, will not be widely acceptable. The author's point of view is well expressed by the statement that an inflamed area is shunted off from the rest of the organism; it has its own metabolism, hydrogen-ion concentration and modified circulation.

Several chapters define the conditions under which dyes, foreign proteins, inanimate particulate matter and bacteria are fixed at the site of inflammation so that they fail to enter adjacent lymphatics, regional lymph nodes and circulating blood. The mechanism of this fixation, the author finds, is the deposit of a fibrinous network in the tissue and the occlusion of lymphatics by fibrinous thrombi. The significance of actual occlusion of lymphatics by thrombi may be questioned because the flow of lymph from the inflamed part is increased.

His observations on the local fixation of bacteria, measured by the fixation of a colloid dye (trypan blue), at the site of inflammation produced by staphylococcus, pneumococcus and streptococcus, suggest to him an explanation of the divergent ability of these microorganisms to invade the tissues. Staphylococcus aureus produces inflammation that within one hour prevents the penetration of trypan blue from the site of inflammation into regional lymphatics, whereas with pneumococcus this interval is six hours and with hemolytic streptococcus approximately 45 hours.

Observations confirming those of others are described to show that an exudate acquires increased acidity in the later stages of an inflammatory reaction. Parallel with this change, and, he believes, consequent upon it, polymorphonuclear leukocytes are replaced by macrophages. Macrophages survive and predominate when the pH falls to a level of about 6.9 or 6.8. Acidity, the author finds, is in part at least the result of glycolysis and the appearance of lactic acid in the exudate.

Menkin has sought for some substance that puts in motion the phenomena of inflammation and thus explains their apparent uniformity under very varied conditions. He finds evidence that histamine can not be accepted as the agent which, set free by injury of tissue, explains the ensuing vascular and cellular changes. He has extracted from exudates a crystalline, doubly refractive nitrogenous substance which contains amino- and carboxyl groups. It is not protein, but its chemical composition is not more exactly definable. It increases the permeability of blood vessels to fluids and to dyes and induces the migration of leukocytes. It does not produce in the body the well-known reactions of histamine. The author has designated this substance leukotaxine and thinks that the available evidence supports the opinion that increased permeability of blood vessels and leukocytic migration are referable to it. Nevertheless it should not be forgotten that there are a great number of substances, including many degradation products of proteins, that cause the same changes.

This monograph is an admirable presentation of its subject from the standpoint of experimental biology. The important contributions of the author and his clear definition of some of the problems of inflammation will doubtless stimulate renewed investigation of them. The book reveals very fully the fundamental significance of inflammation in relation to infection and immunity.

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PHOTOELASTICITY

Elasticité et Photoélasticimétrie. By H. LE BOITEUX and R. BOUSSARD. 361 pp. Paris: Hermann and Cie, 1940. 180 francs.

ALTHOUGH the technique of photoelasticity, a practical method to determine complicated two-dimensional stress distributions experimentally, was originated in France by Mesnager in 1901, this is the first French book giving a comprehensive account of the theoretical and practical aspects of the method. It is divided into four sections, of which the first is an exposition of the theory of elasticity in the classical manner. The second section does the same for optics, first of isotropic and later of anisotropic mediums. These two sections comprise half the book and do not as yet mention photoelasticity. In the third section the two theories are combined and a discussion is given of apparatus, experimental techniques and properties of the materials used. The last quarter of the book is devoted to methods of numerical integration for finding the principal stresses individually, which is necessary since the photoelastic pictures only determine the difference between these stresses at each point. It is noted that the authors show a number of colored pictures of stress distributions, which represented good practice a decade ago. Although the superiority of monochromatic light and black-and-white pictures over colored pictures is casually mentioned in the text, the authors evidently do not use the improvement in their own laboratory.

A very complete and encyclopedic book, entitled "A Treatise on Photoelasticity," on the subject was published in 1931 by Coker and Filon (Cambridge University Press) which from a technical standpoint is now somewhat out of date. The present French volume is more clearly written; it is easily readable and presents the theory quite adequately; but, although appearing nine years later, it is no better than Coker-Filon in the technical parts of the subject. And it is just in the technical direction that great advances have been made lately, making the now obtainable accuracy in reading stresses about ten times better than that shown in the book.

Another recent volume on the subject written by Mesmer is entitled "Spannungsoptik."[1] The first half of its total of 220 pages follows the French book in its general structure, while the last half discusses experimental techniques and the more modern applications. The bibliography appended refers principally to the last decade, listing 240 papers published since 1930, whereas the French bibliography practically stops with the year 1931.

The most interesting recent development of photoelastic technique is its extension to three-dimensional stress distributions. This is done by exposing the bakelite model to a load at a fairly high temperature and then cooling it under load. A subsequent removal of the load leaves the model without stress but with optical properties that can be correlated to the stress that existed in it before the load removal. Although not yet developed to the point of being a practical engineering tool, this method shows great promise of becoming such a tool in the near future. It is discussed briefly by Boiteux-Boussard as well as by Mesmer.

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[1] Berlin: Julius Springer, August, 1939.

SPECIAL ARTICLES

ON THE INTERDEPENDENCE OF RESPIRATION AND GLYCOLYSIS[1]

THE following definition of the Pasteur effect has recently been suggested by Burk:[2] (a) O_2 inhibition of fermentative processes, and at times also (b) O_2 stimulation of anabolic syntheses, the latter effect not being invariably concomitant with the former. Crabtree[3] in 1929 found that the respiration of transplantable tumors was about 12 per cent. lower in the presence of glucose than in its absence and suggested that glucolytic activity exerts a checking effect on the capacity for respiration of tumors. This phenomenon has been called a reversed Pasteur effect (or the Crabtree effect). The occurrence of the Crabtree effect in transplantable tumors has been confirmed.[4,5] Likewise, the effect was observed in lymph nodes of leukemic mice.[6]

We have noticed that the inhibition of respiration by the addition of glucose occurs also in normal tissues with an aerobic glucolysis. In the renal papilla of the rat, which is known to have a metabolism similar to tumors,[7] the inhibition amounted to 20 per cent.

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[1] From the Laboratory of Orthopaedic Research of the Harrison Department of Surgical Research, Schools of Medicine, University of Pennsylvania, Philadelphia, Pa.

[2] D. Burk, Cold Spring Harbor Symposia on Quantitative Biology, 7: 420, 1940.

[3] H. G. Crabtree, *Biochem. Jour.*, 23: 536, 1929.

[4] E. Krah, *Biochem. Zeit.*, 219: 432, 1930.

[5] K. A. C. Elliott and Z. Baker, *Biochem. Jour.*, 29: 2433, 1935.

[6] J. Victor and J. S. Potter, *Brit. Jour. Exp. Path.*, 16: 253, 1935.

[7] P. György, W. Keller and Th. Brehme, *Biochem. Zeit.*, 200: 356, 1928.

In bovine articular cartilage which possesses an exceedingly low respiration and thereby a relatively higher aerobic glycolysis than the other tissues mentioned, the inhibition averaged 57 per cent.

Results of a representative experiment with calf cartilage are listed in Table 1. It is seen that glucose retards oxygen consumption by 63 per cent. Similar effects were obtained by the addition of mannose, but no effect was obtained with fructose which is not glycolyzed by cartilage. The inhibition observed in oxygen (53 per cent.) was of the same order as in parallel determinations in air (59 per cent.). The magnitude of the respiratory inhibition in cartilage is neither due to a drop in the pH of the medium incident to the high rate of acid formation after the addition of glycolyzable hexoses to the slices nor to an accumulation of glycolytic splitting products or their derivatives (lactate, pyruvate, succinate). Table 1 shows an example of the results obtained with pyruvate and succinate. Pyruvate does not alter the rate of the spontaneous O_2 consumption, but it induces an acceleration of the oxygen uptake if the respiration is inhibited by glucose. Succinate[8] accelerates respiration in the presence of glucose to a greater extent than in its absence. Apparently the addition of glucose suppresses cellular processes which result in the formation of pyruvic and succinic acids since the addition of these acids abolishes more than half of the respiratory inhibition by glucose (*cf.* Table 1).

TABLE I

THE ACTION OF GLUCOSE ON THE RESPIRATION OF CARTILAGE*
Mean rates over three-hour period

Substrates	None	Glucose	Pyruvate	Succinate	Glucose + Pyruvate	Glucose + Succinate
		(M/100)	(M/50)	(M/25)		
Q_{O_2}†	.079	.029	.079	.103	.062	.080
Inhibition by Glucose	...	−.050 (−63%)	...	...	−.017 (−22%)	−.023 (−23%)
Acceleration by Pyruvate and Succinate	...	...	±0	+.024	+.033	+.051

† Cmm. O_2/mg dry weight/hour.
* Articular cartilage from the metacarpal-phalangeal and metatarsal-phalangeal joints of a calf two months old. About 125 mg dry weight of cartilage slices per experimental vessel. $k_{O_2} = .98$

Gas: Air Medium: Phosphate-Ringer's

Elliott and Baker[5] as well as Victor and Potter[6] observed that the retardation of respiration by the addition of glucose was paralleled by a rise of the R.Q., indicating a replacement of respiratory substrates of the tissue by the added glucose. The latter authors pointed out that the change of the R.Q. after the addition of glucose was compatible with a shift from protein oxidation to carbohydrate combustion. Warburg and colleagues[9] showed that the formation of ammonia in tissue slices deprived of glucose is especially high in glycolytically active tissues and that the addition of glucose inhibited the excretion of ammonia. This inhibition was considered an expression of the protein sparing action of glucose. The investigation of Dickens and Greville[10] indicate that the oxidation of glucose rather than its glycolysis is responsible for the retardation of the protein catabolism. It seems possible that the addition of glucose causes a decrease of oxygen consumption in such tissues in which the hexose is not oxidized with the same velocity as the cellular substrates, the oxidation of which it replaces. Such a mechanism would explain the frequent occurrence of the Crabtree effect in aerobically glycolyzing tissues where a relatively sluggish oxidation of glucose coincides with a high protein catabolism in the absence of sugar.

This tentative explanation does not intend to imply that glucose oxidation replaced only the combustion of protein nor that glucolysis does not prevent to a certain extent protein catabolism, as was suggested by Warburg.[9] The explanation supports the view, however, that the Crabtree effect is not a reversal of the checking action of respiration on glycolysis but a separate process which indicates the sparing of cellular substrates by the combustion of extracellular glucose. Thus, the Crabtree effect may belong to the reactions which underlie the stimulative action of respiration on cellular anabolism (Pasteur effect b).

The mechanism of the effect is being investigated further.

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APPEARANCE OF SKELETAL ABNORMALITIES IN THE OFFSPRING OF RATS REARED ON A DEFICIENT DIET

The following observations were made when rats, which were reared on deficient diets, were bred. All rats used were of the Sprague-Dawley strain. One group of females was reared on a diet consisting of yellow cornmeal 76 per cent., wheat gluten 20 per cent., calcium carbonate 3 per cent., sodium chloride C.P. 1 per cent. (Steenbock and Black rachitogenic diet No. 2965),[1] which was supplemented with viosterol (each rat received 60 I.U. every tenth day). On this diet the animals were retarded in growth and development. The vagina opened at the age of three to four months, the regular cycles started at between four and five months, the first matings took place at between five and six months, at which age the rats weighed only about 150 grams. In this group of 18 animals, 32 pregnancies were observed. A total of 164 young was born either spontaneously or by cesarean section; of these, 107 were apparently normal, while 57 presented multiple congenital abnormalities.

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[8] Lactate behaves similarly.

[9] O. Warburg, K. Posener and E. Negelein, *Biochem. Zeit.*, 152: 309, 1924.

[10] F. Dickens and A. Greville, *Biochem. Jour.*, 27: 1123, 1933.

[1] H. Steenbock and A. Black, *Jour. Biol. Chem.*, 64: 263, 1925.

An abnormally short mandible was found in 39 animals. This defect was so marked that the tongue was exposed to a large extent. Many animals also had deformed extremities. Syndactylism of different grades was observed in 32 young. A short tail was seen in 12 animals. One hundred and four of the young were cleared by the Spalteholz method to facilitate the study of the skeleton. In 42 of these specimens the lower legs showed reduction in size or absence of the tibia; in 20 the fibula was shortened or absent; in 22 there was fusion of the ribs; and in 14 there was fusion of the centers of ossification of the sternum.

Another group of females of the same strain was reared on a more adequate diet consisting of yellow cornmeal 78 per cent., wheat gluten 18 per cent., calcium carbonate 1 per cent., sodium chloride C.P. 1 per cent., and dried pig liver 2 per cent.[2] This diet resulted in much better growth and development of the animals. This group consisted of 24 females which had 39 pregnancies resulting in 294 young. None of the latter showed deformities of the mandible or extremities like those described in the previous group. The only external abnormality observed in the offspring of the animals on this diet was absence of the tail in one animal. Eighty of the 294 young were cleared, but they showed none of the skeletal deformities found in the previous group.

A third group of 12 female rats of the Sprague-Dawley strain was raised on an adequate diet (Bill's modification of Steenbock's stock diet).[3] Thirty litters born to these animals consisted of 216 young. One abnormal animal was noted in this group. It weighed only 2½ grams and when cleared showed short femurs and an abnormal sternum. One hundred and nineteen young in this group were cleared, but they showed no abnormalities.

At the present time we are extending these experiments along both genetic and nutritional lines.

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[2] R. E. Remington, *Jour. Nutrition*, 13: 223, 1937.

[3] C. E. Bills, E. M. Honeywell and W. A. MacNair, *Jour. Biol. Chem.*, 76: 251, 1928.

MODIFICATION OF THE CHEMISTRY AND PHARMACOLOGICAL ACTION OF THE CARDIAC GLYCOSIDES[1]

Alteration of the molecular structure of a drug frequently results in modification of its pharmacologic action. The digitalis bodies exist in nature as chemical combinations of one or more sugars with hydroxylactones of sterol hydrocarbons. This suggests the possibility of modifying the digitalis bodies by replacing the sugar with a vasodilator, thus obtaining a cardiac glycoside molecule which might embody the desirable therapeutic actions of both drugs.

Two molecules of theophylline can be combined chemically with one molecule of a genin obtained by removing the sugar radical from a squills glycoside.[2] This dimethylxanthine genate can be prepared as short needle-like yellow crystals having a molecular weight of 758.2 and an empirical formula of $C_{38}H_{46}O_{9}N_{8}$ (presumably $C_{24}H_{28}O_{3}(C_{7}H_{7}O_{2}N_{4})2\ .2H_{2}O$). When injected intravenously in cats the lethal dose of this theophyllinated genin is much greater than that which might be expected on the basis of the amount of genin used in its preparation. The lethal dose of a mechanical mixture of theophyllin and the genin, on the other hand, is in proportion to its genin content. The theophyllinated genin, the squills glycoside, the mechanical mixture, and also digitalis show the same progression of electrocardiographic changes; T wave inversion and ventricular premature beats occur with the same degree of frequency, while nodal rhythm and ventricular tachycardia appear after approximately the same percentage of the lethal dose. Changes in the S-T segment, however, appeared in a far lower percentage of the animals given the theophyllinated genin than in those given digitalis, squills glycoside or a mechanical mixture of theophyllin and the squills genin.

These preliminary studies suggest that dimethylxanthine and the squills genin have been combined in a single molecule retaining some of the digitalis-like properties and modifying others. Further studies of the chemical and pharmacological properties of this preparation are necessary as well as clinical studies to ascertain the therapeutic value of the drug.

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THE NATURE OF THE ANTI-ALOPECIA FACTOR

It has recently been shown[1] that the mouse requires a new vitamin for normal growth and for maintenance of hair. The dietary essential which prevented or cured the pathological manifestations was termed the mouse anti-alopecia factor. In its absence from the diet, growth ceased and extensive alopecia developed, followed by severe dermatitis. Liver was found to be a good source of the protective factor, and concentrates were prepared from this organ.

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[1] From the Medical Research Department of the Beth Israel Hospital and the Department of Medicine, Harvard Medical School, Boston, Mass.

[2] This preparation was supplied by Parker Dorn, Inc., Worcester, Mass.

[1] D. W. Woolley, *Jour. Biol. Chem.*, 136: 113, 1940.

Many of the properties of the active substance suggested that a phosphoric ester of inositol was involved. For example, our best concentrates contained organically-combined phosphorus. The active substance was precipitated by barium hydroxide and was insoluble in alcohol. Furthermore, it was found that cereal grains, known to be good sources of the phosphoric ester of inositol, were also good sources of the anti-alopecia factor. All these facts seemed to justify a test of the potency of phytin, the salt of inositol phosphoric acid. While the assays were in progress, a crystalline substance was isolated from active liver concentrates which proved to be inositol. Phytin caused restoration of hair and resumption of growth in the depleted animals. Activity was not limited to the phosphoric ester, for inositol itself was subsequently found to be potent.

Assays were performed as described previously, and were always based on curative rather than preventative technique. For both phytin and inositol the level fed was 100 mg per 100 gm of ration. Cures have also been obtained with 10 mg of inositol per 100 gm of ration. Gain in weight, as well as restoration of hair, followed administration of these substances.

Inositol was isolated from the non-dialyzable, alcohol-insoluble portion of aqueous liver extract. This fraction had been autoclaved with alkali in order to render the active substance dialyzable. The crystals which were obtained melted at 214–216° and had a carbon content of 39.8 per cent. Inositol in the same bath melted at 215–216°.

The above facts indicate that the mouse anti-alopecia factor is inositol or its derivatives. They suggest that inositol exists in liver in alkali-labile combination with a large molecule which renders the former non-dialyzable. While it has been reported[2] that inositol stimulates the growth of certain strains of yeast, its place in the nutrition of higher animals has not previously been observed. Details of the work will be published elsewhere.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW TYPE OF SHIELDED GLASS ELECTRODE[1]

The high resistance of glass electrodes and their consequent sensitivity to stray currents require careful shielding in addition to an adequate insulation. The shielding is important when the electrode is to be employed at distances from the measuring apparatus that require long leads. This shielding is ordinarily accomplished by the use of a more or less flexible metal sleeve, thus providing an equipotential layer around the lead. The sleeve is conveniently connected to the equipotential shield about the measuring apparatus. Commercially manufactured shielded wires are frequently employed.

The special feature of the shielded glass electrode now to be described is an arrangement by means of which the KCl-solution which ends in a fluid junction surrounds completely the stem of the electrode and the entire lead up to the terminal of the measuring apparatus. In this manner the KCl-solution that is a part of the low resistant half of the circuit acts as a shield against external stray currents. With our equipment best results were obtained when the terminal of the reference half cell was connected to the equipotential shield around the potentiometer or directly to the ground.

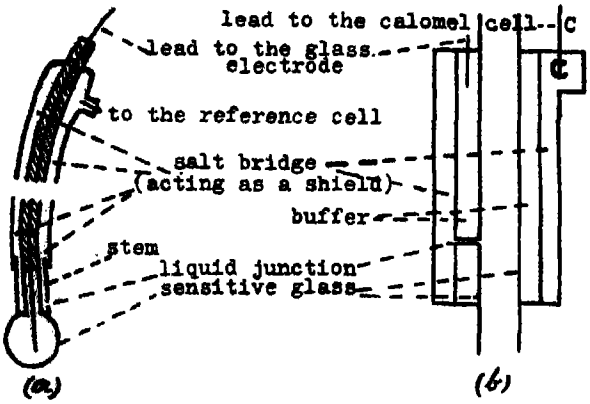

Fig. 1. Diagrams of glass electrodes (a) bulb type, (b) condenser type with the use of the salt bridge as a shield.

Fig. 1 shows two types of glass electrodes, the bulb type (a), and the condenser type (b), also used as a continuous flow electrode with the use of the KCl-solution as a shield.

The arrangement calls for a very careful insulation of the leading wire against the surrounding fluid. Its advantages are twofold: (1) With a metal shield there is always some space between the shield and the conductor, thus producing a condenser with the resulting disturbances usually seen on bending the metal shielded wire. In the type described, the KCl-salt bridge fills the space between the insulated wire and the outer cover entirely and follows uniformly any movement of the flexible lead. Merely a film of liquid or semi-liquid, as used in agar-KCl or similar bridges, is sufficient for the shielding. $BaSO_4$ or another x-ray-opaque material may be added when location of the electrode by fluoroscopy is desired. (2) The combination of the glass electrode and the reference half cell in one piece saves space and is easy to handle. Even a calomel or another reference half cell may be incorporated to form one piece with the electrode as seen in Fig. 1 b. The use of this type of shielded electrode is of particular advantage in the measurement of pH in body cavities.

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[1] From the Laboratory for the Study of Peripheral Vascular Diseases, Department of Surgery, New York Hospital and Cornell University Medical College.

[2] E. V. Eastcott, *Jour. Phys. Chem.*, 32: 1094, 1928.

A more detailed description of a measuring device, in which this type of shielded glass electrode is used in the determination of intestinal pH, with a report of clinical findings will be presented later.

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A DIRECT METHOD OF DETERMINING THE ERYTHROCYTE, LEUCOCYTE AND THROMBOCYTE COUNT OF FOWL BLOOD

A MODIFICATION of the Blain method of staining the leucocytes in bird blood yields a rapid, reliable means of enumerating the cellular elements of the blood in the counting chamber. Two solutions are employed, the first containing the stain and the second the preservative for the cells. Because granulocytes have an affinity for brilliant cresyl blue and lymphocytes for pyronin, a stock solution of these is prepared consisting of 1 cc of 1 per cent. aqueous brilliant cresyl blue and 0.25 cc of saturated aqueous solution of pyronin (1 gram in 15 cc of water).

The first solution for staining used in the method described herein consists of 0.2 cc of the stock dye mixture in 25 cc of normal saline. This is filtered once through neutral paper. The second solution is that employed by Blain—12 per cent. of formalin in Locke's solution.

Blood is procured from the wing vein, and immediately after puncture it is drawn up to the 1 mark in the red-cell counting pipette. The pipette is then half filled with the first solution, gently rotated for about five seconds, and then filled to the 101 mark with the second solution and shaken for half a minute to mix. Counts may be made at once, although better differentiation is obtained if the mixture is allowed to stand 15 minutes or more. Thin covers, not more than 0.5 mm in thickness, are used, and the preparation is studied under a 4 mm objective.

The erythrocytes appear as pale oval discs with the nuclei sometimes barely perceptible. The thrombocytes vary from pale ovals slightly smaller than the erythrocytes and with a single polar granule, to small lance-shaped, faintly lilac-colored bodies. The latter type tends to occur in clusters and is more numerous in specimens made just before clotting begins, *i.e.*, after one or more pipettes have been filled in succession from the same puncture. The heterophiles take varying quantities of the blue dye and stand out sharply as blue-black bodies slightly smaller than the erythrocytes. The lymphocytes are uniformly round, faintly pink bodies, clearly distinguishable from thrombocytes, which in their colorless state appear to belong more to the erythroblast series. Monocytes are indistinguishable from the large lymphocytes, but since this is not primarily a differential count, that is not important.

Checked against Shaw's method over a series of blood counts on the bobwhite quail, this method gives approximately the same total leucocyte count and has the added advantage that the solution is more stable than Shaw's. The solution containing the dye will keep for about a week. The stock solution is less stable, but the dyes kept separately in solution are good indefinitely. The formalin solution must be made fresh each day, but adjustment of the pH and temperature are unnecessary.

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SCIENCE FIVE THOUSAND YEARS HENCE[1]

By Dr. ALBERT F. BLAKESLEE

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I HAVE been asked to predict the condition of science five thousand years hence when the Time Capsule is dug out of the Flushing meadows—provided there are any meadows here in A.D. 6939. Land has been rising and falling in different parts of the globe within historic time, and within five thousand years the Time Capsule may be considerably below sea level or raised several hundred feet above where it is now.

While I speak *to* the youth of to-day, I am speaking *for* the youth that will be living one hundred and fifty generations hereafter, in other words to your great, great, one hundred and fifty times great grandchildren.

One can predict only in terms of what is known in the past. Let us compare what has actually occurred within these fifty centuries with what a man five thousand years ago might have predicted for the present. He could not have thought about development of world civilization because the world to him was only a limited region. Civilizations could develop and decline with little or no influence on one another because of lack of means of communication. His knowledge of the geographical world and of the laws of nature was so limited that it would have been impossible for him to predict the condition of the world in 1940. Science, as we understand this term, did not exist in B.C. 3060.

Are we to-day in our ignorance as incapable of predicting the future five thousand years hence as was the man five thousand years ago? In many ways probably yes; in other ways we have an advantage.

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[1] Address before the American Institute of the City of New York at the World's Fair, September 23, in connection with the sealing-in of the Westinghouse Time Capsule. The address was broadcast in part over the NBC network.

We have made a start. So far as his physical and his mental equipment are concerned, I see no evidence that man to-day is better than five thousand years ago. He does, however, have better tools—by tools I include the methods of science as well as the actual instruments, such as the microscope, which enable him to delve deeper into the unknown and learn the laws of nature. The development of science seems to act like a falling body in that, once started, its speed is enormously accelerated with time. There is an interrelation of science such that each new tool or method makes possible newer tools and further discoveries. In many branches, and perhaps in science as a whole, more progress has been made within the life span of a single man than in all time before.

Last week I had the privilege of taking part in the celebration of the bicentennial of the founding of the University of Pennsylvania by Benjamin Franklin. Two hundred years is not a long time so far as the recorded history of mankind is concerned. It is only a one-twenty-fifth part of the period of time we are discussing to-day. Two hundred years is a long time, however, in the history of my own field of biological research. In 1740 Benjamin Franklin and the other founding fathers of the University of Pennsylvania knew little about biology for the simple reason that biology at that time was an almost undeveloped subject. An adequate system of naming plants and animals was lacking, and it was only thirteen years later, in 1753, that Linnaeus published his "Species Plantarum" and introduced to the world the binomial system of classification which has been used ever since for the names of both plants and animals. Few of the titles of the biological papers which were given at last week's celebration in Philadelphia could have had any meaning to Franklin and his colleagues because such words as *germ plasm, chromosomes* and *genes* were not in use till more than a century after Franklin's time.

A couple of years ago at the Richmond meeting of the American Association for the Advancement of Science there was celebrated the one-hundredth anniversary of the cell theory. The newness of our knowledge of cells is evident when we realize that more than two thirds of the last century's study of cells is covered by the life span of one of the speakers on the program of the Pennsylvania Bicentennial. Chromosomes were discovered in 1873 when he was three years old and were given the name of chromosomes in 1888, when he was an eighteen-year-old freshman in Kansas University. An example from my own special field of genetics is the fact that knowledge of the mechanisms of heredity has been developed entirely within the last forty years. Progress was slow at first but has become increasingly rapid until now we feel justified in predicting the conscious control of the evolution of plants, animals and even of man himself. Thus in addition to having more and better tools, man, five thousand years hence, may be a better creature physically, mentally and morally.

Detailed prophecies, of course, are impossible. We can only guess at trends. The psalmist said, "Oh! had I wings like a dove, for then I would fly away and be at rest." Many doubtless have had the same desire to fly. Leonardo da Vinci less than five hundred years ago drew plans of a flying apparatus. It was only, however, after the invention of the internal combustion engine that flying became an accomplished fact. This was the outcome of centuries of yearning. We make progress in learning by yearning. If we study what the things are which mankind yearns for, we may be sure that these will be things in which progress will have been made five thousand years from now.

We have yearned not only for wings, which we have now acquired, but also that we may fly away and be at peace. I believe within five thousand years man will have made progress in satisfying this yearning; whether by changing his environment through improvements in social organization or through changing the nature of man, we can not foretell. I believe progress is due in knowledge of how man may live in harmony and at peace in large as well as in small groups. I believe that governments will depend increasingly on expert knowledge—that we shall seek information before legislation rather than the reverse. I believe that by the scientific method we shall more effectively seek the truth and that the truth shall make us free.

THE VALUE OF THE FUNDAMENTAL SCIENCES IN THE ESTABLISHMENT OF ANESTHESIOLOGY[1]

By Dr. JOHN S. LUNDY

SECTION ON ANESTHESIA, THE MAYO CLINIC, ROCHESTER, MINNESOTA

THIS seems to be a suitable occasion for an individual who has had an opportunity to participate in the development of anesthesiology,[2] a new specialty in medicine, to call your attention to the fact that the fundamental sciences are the outstanding factors in the further development of this specialty. For a great many years anesthesia was largely an art, but now it is developing also into a science and into a major specialty of medicine. This progress has been recognized with the establishment of an Examining Board in Anesthesiology for the purpose of certifying those physicians who are considered to be competent to specialize in that type of medical practice. The American College of Surgeons and the American Medical Association both recognize this board and are advised by it in regard to certain surveys of anesthesia services that are made throughout the nation in the various hospitals. The rating of the hospitals in respect to anesthesia depends on how well they are supplied with anesthetic agents, what methods of anesthesia they are equipped to use, what library facilities in anesthesia they possess and what personnel trained in anesthesia they employ. Certain of the institutions do not attempt to teach, while others are considered to be satisfactory places for men to take training. At the New York World's Fair it was noted that more than 1,000,000 people interested themselves in the exhibit on anesthesia which was there.

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[1] Read before the meeting of the North Dakota Academy of Science, Fargo, North Dakota, April 26, 1940.

[2] J. S. Lundy, E. B. Tuohy, R. C. Adams, L. H. Mousel and T. H. Seldon, *Proc. Staff Meet., Mayo Clin.*, 15: 241–254, 1940.

There are societies of anesthetists and there are publications devoted to anesthesiology. I have had a hand in the development of one of them, *Anesthesia Abstracts.* The idea underlying this publication was obtained from *Chemical Abstracts, Botanical Abstracts, Physiological Reviews* and other magazines of a type which have been found very valuable to workers in the fundamental sciences. It seemed to me that a periodical of similar type should be equally valuable to those engaged in a specialty of clinical practice; happily for me the reception accorded this periodical justified my assumption.

In the effort to outline the development of the scientific side of anesthesiology, it is worth while to point out some of the incidents that illustrate the interrelation of the anesthetist and the scientist. The relationship of art and science in the development of a specialty was well stated by Jevons who said, "Science teaches us to know and an art to do."

The history of anesthesia dates back to the time of Herodotus, when concoctions of hemp and mandragora were used to stupefy the sensibilities of individuals who must undergo pain. It is said that even the ancient Chinese used opium to mitigate the horrors to which condemned criminals were subjected in order that the people, ignorant of the insensibility of the victims, might be impressed by the punishment, while those who enforced the law would not hesitate to carry out the sentences. In more recent years Henry Hickman, a young British physician who attempted to work in the field of relief of pain, carried out many experiments with various substances, among them carbon dioxide, but he died an early death filled with disappointment because of lack of sympathetic help and understanding from others. Another young British physician, John Snow, did pioneer work (1850) in the scientific study of ether, use of which for anesthesia had been made known by the dentist, William Morton of Boston. Both of these men died in disappointment, both when they were less than fifty years of age. Horace Wells, dentist of Hartford, Connecticut, introduced nitrous oxide as an anesthetic agent in 1844 and he ended his life shortly thereafter without having received the support of the dental or medical professions. Crawford Long of Georgia used ether in 1842, and for this he was harassed by the inhabitants of his community. Sir James Simpson of Scotland, who introduced chloroform, was persecuted by the people and only overcame their objections through royal favor. Very recently Howard Jones introduced a method of spinal anesthesia and, because of unfavorable criticism and non-support of his efforts, committed suicide. The lives of these men represent some of the unhappiness that has surrounded the development of the specialty of anesthesiology and serve as examples of the hindrances to the development of any specialty if support is withheld. Fortunately, there is a happier side to the story and it is that about which I would like to speak.

In the last twenty years opportunities have been made available to certain physicians throughout the United States and Canada, who are interested in the administration of anesthetic agents, to put into practice ideas that have come to them both in regard to clinical practice and to research. These individuals have become known and, as a result, drugs have been presented to them for investigation. When a new method of anesthesia has been devised these investigators usually have had a part in furthering its clinical application. Many a scientist has advised and cooperated with them in institutions of higher learning and they also have cooperated with scientists who are engaged in the development of new commercial products that are useful to the anesthetist. As a result, to-day training in anesthesiology is available in several places and more positions are available in this field than there are trained persons to fill them. This situation probably will continue to exist for at least the next fifteen or twenty years. It is, I believe, a pleasant thing to contemplate that opportunities do exist for young people in this field and that coexistent with those opportunities are many opportunities for contributions to the relief of human suffering. This situation will continue to exist, however, only if those engaged in work in the fundamental sciences will continue to cooperate in the future as they are doing at present. Therefore, if there are in this audience those who wish to investigate phases of anesthesiology which might well prove interesting to them, they will find the anesthetist eager to discuss the problems that face him and, in turn, to furnish his share of cooperation.

I believe I can best illustrate some of the benefits of this cooperative effort by citing certain happenings of the past. Let us take at random a few of the sciences that are represented in this room and mention some of the contributions they have made to anesthesiology; we can not attempt to enumerate the contributions of all the sciences. The science of anatomy is of fundamental importance to all branches of medicine, including that which includes the anesthetist. Often he must deposit a local anesthetic agent near a given portion of a certain nerve trunk for purposes of producing anesthesia for operation or for diagnosis or for purposes of therapy. To know the location of blood vessels is important so that they may be avoided or entered accurately, as the occasion may require. Knowledge of the bony landmarks is essential in the localization of nerves and vessels. The anatomy of the respiratory passages is necessary knowledge to him who would administer anesthetic substances by inhalation. To know the anatomy of the colon is useful when anesthetic agents are to be administered by bowel. An anatomist's contribution that at first would seem to have to do only with his own science is the work of Clark, of Philadelphia, who devised a means of observing capillaries through an artificial window in a rabbit's ear. This device had been in use for thirty years when, about a year and a half ago, T. H. Seldon[3] began to utilize it for investigation of the effects of certain anesthetics on the capillaries. Much valuable information may be obtained from this application of Clark's investigation of capillaries, for it is not easy to find test objects that will give reliable information.

The work of Rosenow and Tovell,[4] in studying the cause of convulsions under general anesthesia has provided a possible solution of the problem through bacteriology. In the field of botany and horticulture, Knight, working with Crocker,[5] discovered that the ethylene portion of illuminating gas would put carnations to sleep. This information was related to Luckhardt,[6] the physiologist, who tried the gas on mice and then on himself and his other laboratory workers. Attention was called to it as an anesthetic agent for clinical use and it was administered by Dr. Isabella Herb in clinical practice at Presbyterian Hospital in Chicago. Recently when the supply of ephedrine was reduced because of the war in China, the plant Mahjung was cultivated in Brookings, South Dakota, thus showing how anesthetists may keep themselves supplied with this valuable stimulant to the cardiovascular system.

The contributions of chemistry have been of great value. Without them, much of the rapid development in the use of new anesthetic agents and certain other drugs would not have been accomplished. The isolation or manufacture of oxygen, nitrous oxide, carbon dioxide and cyclopropane, of ether and chloroform and ethyl chloride were gifts of chemistry. The synthesis of the barbiturates and of the local anesthetics, cocaine, procaine and others, also are contributions of chemistry, and it is to be hoped that further contributions will be made in the near future. The rapid development of the intravenous method of anesthesia parallels the rapid development of these barbiturates so that, between 1924 and 1934, we learned of the synthesis of barbiturates that would produce long-lasting anesthesia, then of other substances of the series that would bestow anesthesia for a somewhat shorter period and, finally, of still other barbiturates that would cause anesthesia of sufficiently brief duration so that the method is now firmly established in clinical practice and is becoming widely used throughout the world. The investigations of biochemists in the developing of new quantitative methods of analysis for the identification of drugs has made it possible to investigate many problems in anesthesia. As examples, I might cite the work of Dunlop,[7] in Osterberg's laboratory, where a method of identifying procaine in great dilution was employed. This permitted Dunlop to investigate the fate of procaine in the dog and he was able definitely to establish the role of the liver in the destruction of this drug (1935). Delmonico,[8] also working in Osterberg's laboratory, carried out a method of quantitatively estimating samples of barbiturates. This method permitted Delmonico to investigate the fate of certain barbiturates in the body. These are two of innumerable instances wherein methods developed through chemistry have permitted investigation of anesthetic agents used clinically and experimentally. Without the aid of chemists the work could not have been begun.

Physics has taught us to understand some of the actions of gases and liquids and also has contributed methods of measurement that have broad application in the field of anesthesiology. At present, a means of analyzing mixtures of gases by passing them through a fixed, small aperture under constant pressure, and timing the flow, is giving good results in the hands of H. O. Brown[9] working in Boothby's laboratory. The physical principles concerned in the use of a light gas, such as helium, in the treatment of asthma is an illustration of the practical clinical application of physical principles. The clinical problem is that the patient is unable adequately to ventilate himself with air because air can not be easily drawn through the air passages, the caliber of which has been diminished by the disease, without extreme physical effort. However, by using a mixture of oxygen and helium rather than the mixture of nitrogen and oxygen that exists in air, the patient is able to breathe with not more than the physical effort exerted by a well person. Another application of physical principles has caused a therapeutic procedure to be developed, the use of which is becoming well recognized and will be widely applied. It concerns the difficulty of a patient after operation to ventilate himself with air or oxygen when there is present in his air passages any solid or fluid material which tends to obstruct his respirations. It has been found that by inserting a lighted, tubular instrument into the air passages, the obstructing material can be aspirated. This permits the patient to breathe in more normal fashion and often to avoid the development of pneumonia which carries with it a considerable mortality or subsequent morbidity.

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[3] T. H. Seldon, unpublished data.

[4] E. C. Rosenow and R. M. Tovell, *Am. Jour. Surg.*, 34: 474–485, 1936.

[5] Crocker and Knight, quoted by A. B. Luckhardt and J. B. Carter.

[6] A. B. Luckhardt and J. B. Carter, *Jour. Am. Med. Asn.*, 80: 765–770, 1923.

[7] J. G. Dunlop, *Jour. Pharmacol. and Exper. Therapy*, 55: 464–481, 1935.

[8] E. J. Delmonico, *Proc. Staff Meet., Mayo Clin.*, 14: 109–112, 1939.

In the field of electrical physics many contributions have been, and will be, made. An example is the use of the photo-electric cell in determining the coagulation time of blood. The use of the electrocardiograph has permitted study of the effect of various anesthetic substances on the heart. Betlach[10] used the string galvanometric electrocardiograph. Others have used more modern apparatus and the problem remains one of those which will be of interest in the future. I am greatly interested to see whether or not devices may be made that will permit us to follow functions of the cardiovascular system in many operating rooms and bedrooms throughout several hospitals and correlate information for the benefit of patients who are unable to help themselves. Both anesthetist and physicist are greatly interested in air conditioning of operating rooms and hospital rooms; the physicist must provide means of testing the air and the physician must observe any untoward effects on the patient. The loss of body heat by the patient also concerns both physicist and physician, and this problem must yet be investigated. Control of static electricity has become of great importance to the anesthetist recently because he employs various inflammable and explosive mixtures in connection with inhalation anesthesia. Here again the anesthetist must turn to the physicist for information. An excellent example of cooperation in this problem has been the combined efforts of Tovell and Woodbridge, respectively of Connecticut and Massachusetts, together with Horton of the Massachusetts Institute of Technology. From their study has come the intercoupler, a device which connects the anesthetist, the gas machine, the patient and any fourth object or person that must be brought in contact with them. The principle is that the static electricity must pass through a given amount of resistance so that it can not suddenly reach its objective and cause a spark that is hot enough to ignite the vapor or gases. So far as I know there have been no explosions where this intercoupler has been used.

In resuscitation, a type of work which naturally falls to the anesthetist, the physicist has a real interest. Mechanical means of producing artificial respiration have been investigated and some of them have proved effective, although much remains to be done in this field. The so-called iron lung has proved of value, and in surgical cases mechanical devices for pulmonary ventilation have been useful. However, because of the expense of the equipment and the consequent small demand for it, the field has not been thoroughly investigated. In the administration of anesthetic agents by inhalation it has been necessary for so-called gas machines to be devised. Again, physical principles govern the construction of these devices but the construction is not always carried on under the direction of a physicist; this no doubt has retarded the development of an entirely satisfactory machine. For example, when it was decided that ether should be administered with gases an attachment for administration of ether was added to the gas machine. The flow of the gases through the ether bottle resulted in an undetermined concentration of ether in the breathing bag. As yet, no one has devised a means of indicating when concentration of this ether vapor is too strong and consequently the use of the gas machine is often unsatisfactory.

The preservation of blood by chilling has been a great boon to the physician, who frequently finds use for the transfusion of blood. It is to be hoped that some physical means other than centrifuging may be developed for the purpose of separating the cellular elements of the blood from the fluid portion. There are many uses for blood and many uses for each of the elements of blood. The existence of war increases the urgency for solution of this problem.

When venipuncture is difficult because of smallness of veins, it has been shown that by application of heat to an extremity, small veins may be better filled and venipuncture made easy.

The fields of pharmacology and physiology are of such direct application to the work of the anesthetist that the point need not be especially illustrated. It may be said, however, that many agents and methods contributed by chemists and physicists are first applied by the physiologist and pharmacologist to determine the use to which the new agents or methods can be put before they are applied clinically. While the first agents to be introduced may have come into use without such preliminary investigation, those that are introduced to-day are subjected to thorough tests. The interest of the physician anesthetist in the effects produced by anesthetic substances and other drugs which he uses is evident in the work of Searles,[11] who studied the effect of ether and sodium amytal anesthesia on the blood. Such investigation emphasizes the importance of collaboration of clinician and scientist for, if possible, the separate effect of the anesthetic and of any other drug that may be used must always be determined. It is in this field that the study of psychology becomes important, for it must never be forgotten that the psychologic processes of the animal differ from those of the human being. Therefore, it is not always possible to apply the information obtained from animal experimentation to clinical application of the agent.

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[9] H. O. Brown, unpublished data.

[10] C. J. Betlach, *Jour. Pharmacol. and Exper. Therapy*, 61: 329–337, 1937.

The study of languages requires the attention of the anesthetist. Obviously, in scientific writing, many of the same words are adopted by users of different languages, but it is of great importance to the reader of scientific articles that the author should have had at his command a sufficient choice of words that his meaning may be exactly expressed and that, if his article is translated into another tongue, it will not suffer thereby.

By mathematicians many fundamental contributions had been made, usually through physics; however, the mathematician is indispensable in the correlation of data that are gathered not only in the course of experimentation but also in clinical application of anesthetic preparations. It is not easy for those of us who are not mathematicians to assemble statistics derived from our work and properly to interpret their value.

I hope that these illustrations of the indispensable value of the fundamental sciences in the establishment of anesthesiology, a new specialty in medicine, will interest you sufficiently so that your continued assistance may be anticipated. Unfortunately, those of us who are interested in the development of this new specialty and those who will follow us in the field of endeavor are not sufficiently well equipped from your point of view. In the absence of an individual genius, then, development of the new medical specialty will, in all probability, take place in institutions where scientists and clinicians can work together and where facilities exist whereby investigation can be carried on, new facts established and new agents and methods developed; these factors, together, will permit further reduction of pain among human beings. In the future, I hope that animal experimentation, made painless by anesthesia, will be accepted by those who have condemned it in the past when their attention is called to the fact that needless pain caused by disease will be spared both animals and man.

OBITUARY

PHOEBUS AARON THEODOR LEVENE

1869–1940

PHOEBUS AARON THEODOR LEVENE, member emeritus of the Rockefeller Institute for Medical Research, died at his home in New York City on September 6, 1940. He had returned from a vacation in Montana but a short time before, and was about to resume his insistent quest for the knowledge of life processes.

Dr. Levene was born in Sagor, Russia, on February 25, 1869. When he was about two years old, the family moved to St. Petersburg.

The young Levene entered the Classical Gymnasium, and from this school he enrolled in the Imperial Military Medical Academy in St. Petersburg. He was one of the five Jewish students allowed to enter his class. At that time Borodin was the professor of chemistry. It was Borodin's son-in-law, Professor Dianin, who allowed Levene to carry on work at will in the chemical laboratory.

During the year 1891, because of the growing anti-Semitism in Russia, and the resulting need for education of the younger members of the family, the Levenes migrated to the United States, arriving July 4, 1891. After a few months, Levene returned to St. Petersburg to finish his examinations for his medical degree. He was graduated in the autumn of 1891. He returned to New York in March, 1892, and soon took his examinations for the practice of medicine and practiced on the lower East Side until 1896.

Because of his conviction of the importance of chemistry to the advancement of medical science, he enrolled at Columbia as a special student in the Department of Chemistry in the School of Mines. At the same time Professor J. J. Curtis kindly gave him a place to work in his laboratory at the College of Physicians and Surgeons. In later years he supplemented this training by periods spent in Berne under Professor Drechsel, in Marburg under Professor Kossel, in Berlin under Professor Emil Fischer and in Munich in the Technische Hochschule.

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[11] P. W. Searles, *Am. Jour. Surg.*, 41: 399–404, 1938.

Levene's strong bent toward research on the chemical nature of biological materials was but partly satisfied in the limited time permitted by his medical practice. To the good fortune of biochemistry, the way was opened for him to devote all his efforts to these studies by his appointment in 1896 as associate in chemistry at the State Pathological Institute of New York.

In November of the year 1896 he developed tuberculosis and went to Saranac Lake as a patient of Dr. Baldwin. He then went to Davos for a year. All this time Professor von Giesen held the post in the State Pathological Institute open for him. When he returned from Switzerland, though far from well, he at once went to work. During the years 1900–1902 he worked at the Saranac Laboratory for the Study of Tuberculosis because the State Pathological Institute was undergoing reorganization. In 1902 he returned to work there under Dr. Adolf Meyer.

In January, 1905, came his great opportunity when at the invitation of Dr. Simon Flexner he joined the small group who formed the laboratory staff of The Rockefeller Institute for Medical Research, where in July, 1907, he was advanced to the rank of member.

The Rockefeller Institute provided the ideal environment for the flowering of his genius. The stimulus of an inspiring atmosphere, the unexcelled laboratory facilities and the opportunity for choice of problems without regard to their difficulty and length afforded a widened horizon of scientific endeavor to which he devoted his abilities for thirty-five years. Under his sympathetic guidance several distinguished biochemists laid the foundations of their important careers. In July, 1939, he retired and became a member emeritus of the institute but still continued his researches with unabated energy.

Dr. Levene's eminence in his chosen field was recognized by the award to him of the Willard Gibbs Medal of the Chicago Section of the American Chemical Society in 1931, and of the William H. Nichols Medal of the New York Section in 1938. He was a member of the National Academy of Sciences, American Philosophical Society, Bayerische Akademie der Wissenschaften, Royal Society of Science (Upsala, Sweden), Halle Akademie der Naturforscher, Société Royale des Sciences Medicales et Naturelles de Bruxelles and many professional societies.

Dr. Levene married Anna M. Erickson, of Lewistown, Montana, in 1920. Through their congenial tastes there grew a home of spiritual and artistic harmony, the center for a wide circle of devoted friends from many fields.

In such fortunate circumstances Dr. Levene displayed an extraordinary capacity for hard work. He read voraciously in several languages on many subjects. In addition to directing the researches of a number of coworkers, he carried on with his own hands a large volume of experimental work of great delicacy. In the laboratory and in his private library at home, chemistry and its medical significance were a supreme passion; in the midst of his friends, he gave full play to his varied interests in classical and modern art.

To discuss the wide scope of Levene's scientific activities in the space of a few paragraphs is not easy. Fortunately for the reviewer, however, although these researches relate to almost all fields of biochemistry, they present a logical and coordinated pattern. He wrote a number of comprehensive summaries and two monographs, in the preparation of one of which it was the privilege of the writer to collaborate.

Dr. Levene began his career of independent research with an investigation of the transformation of proteins into carbohydrates by the animal organism. This undertaking was an intuitive expression of his lifelong interest in these two important types of biological materials. Two of his early studies were of outstanding significance to protein chemistry: improved analytical methods, developed in collaboration with Dr. D. D. Van Slyke, and the isolation of one of the first crystalline intermediate products of protein hydrolysis, in cooperation with Dr. George B. Wallace.

Of all tissue components, the proteins have offered the supreme challenge to the skill and ingenuity of the chemist. At the beginning of this century the work of Emil Fischer had resulted in his enunciation of the polypeptide theory of structure, based on the isolation of various amino acids from the hydrolytic products of these complex molecules. During the nineteen-twenties this theory was challenged, particularly by a hypothesis in which the molecule was regarded as being made up of diketopiperazine rings—condensed amino acid cycles—joined by auxiliary valence forces. Levene had previously noted the great ease with which a substance of this latter type, isolated by him in 1906, lost its optical activity. A systematic study, extending over several years, of the racemization of a series of synthetic diketopiperazines and peptides revealed the difference in behavior of the two groups of compounds. When this technic was applied to the proteins themselves, they were found to resemble more closely the chain structures than the cyclic compounds, thus supporting Fischer's theory.

The major emphasis in Levene's protein studies, however, was on his brilliant investigations of the characteristic non-protein constituents of the nucleoproteins and of the glycoproteins, namely, the nucleic acids and the nitrogenous sugars, of which brief mention will be made later. It should be noted that both these types of substances are substituted sugars, thus forming a logical connecting link between his broad interests in proteins and the carbohydrates.

As in the case of proteins, two conflicting theories have been advanced for the structure of the polysaccharides, one claiming a union of the individual components in chain form by chemical valency, the other assuming cohesion of ring forms through subsidiary valency. Levene's approach to this problem was through the study of the natural tendency toward condensation of the simple sugars under mild conditions. In practically every case the product was found to be a chain structure. The results have therefore supported the chemical valence theory of union between parts of the polysaccharide molecule, a view now generally accepted.

Two other important aspects of sugar structure received illumination through Levene's researches—the evolution of a method to determine the point of linkage in substituted carbohydrates and the elucidation of ring structures of sugars and their derivatives. Both technics were essential in unraveling the complicated formulas of the nucleic acids.

At the beginning of this century, knowledge of the structure of the nucleic acids, which are essential constituents of the chromosomes, was in a rudimentary state. It had been shown only that they were composed of phosphoric acid combined with nitrogenous and non-nitrogenous substances. There was no information regarding the nature of the non-nitrogenous compounds, the quantitative relationships between the different components or their mode of union.

Throughout four decades these substances were under persistent investigation by Levene, with the result that their structures are now known in detail. The identification of the sugar in the so-called animal nucleic acid, which had baffled all investigators, was finally achieved in 1929 through his genius. He showed that the nucleic acids are tetranucleotides, each of the latter being composed of phosphoric acid, sugar and a nitrogenous compound. The sequence of the union of the constituents and the positions of the substituents on the sugars were then established. The sugars—ribose in plant nucleic acid and desoxyribose in animal nucleic acid—had not previously been known to occur in nature. As a result of Levene's work we have an exact concept of the structures of these huge molecules, probably the most complex biological materials whose architectural picture has been reconstructed.

At an early stage in his work Levene became interested in the unique group of substances known as glycoproteins, which contain high percentages of carbohydrate. These complex compounds were revealed by him to be derivatives of nitrogenous sugars.

The nitrogen-containing sugars in themselves constituted an extremely difficult problem. Whereas in simple sugars the position in space of every substituent had been determined, that of the nitrogen atom could not be assigned by the methods of classical organic chemistry. New, indirect procedures had to be discovered. For this purpose Levene undertook an exhaustive synthetic study of the nitrogenous and the corresponding non-nitrogenous hexoses and their derivatives. From the data the allocation of the nitrogen was deduced. This investigation marked the beginning of his fundamental studies on the correlation of chemical structure with optical activity.

Another group of compounds of complicated formulas, the lipoids, was brought into orderly classification through Levene's researches. The literature was in a sadly confused state, with as many substances described and separately christened as there were authors. By evolving methods for the preparation of these materials in pure state, however, he was able to create scientific order out of chaos in this domain. He showed that three main groups of substances exist among lipoids, two phosphorus-containing and the third phosphorus-free. Closer study demonstrated the fact that two contained a sugar in their molecules, thus cementing their relationship to his studies on other types of carbohydrates.

Through Levene's investigations on optically active materials, particularly among the sugars and proteins, he came to realize the basic significance of optical rotation both as a tool for the elucidation of structures of naturally occurring substances and as a subject of great theoretical import. The problem of configurational relationships—in preparation for which he had, at the height of his career, to renew and broaden his knowledge of advanced mathematics and physics—was to him in later years the most enthralling subject among his varied researches. In these studies, and in fact throughout all his work, he was outstandingly successful in applying the methods and theories of physical chemistry in the province of biology.

As an example of the broad perspective of his scientific philosophy, his analysis of the biological significance of the chemical individuality of tissue elements may be cited. In the first classification he placed those compounds—such as nucleic acids, lipoids and conjugated sulfuric acids—which, though indispensable to life, exhibit no individuality, no specificity; they are found in all tissues, in all organs of all species, are invariable in their structures and occur wherever life is present. Typical of the second classification—the members of which may be present or absent in one or more organs, in one or another species, but preserve their chemical individuality in various species—are the hormones and enzymes. Finally, in the proteins we encounter a group of substances whose complex relations are still further complicated by the fact that they appear to show differences in chemical structure with variation of species.

To future generations of inquirers into the complexities of living matter, Dr. Levene extended this message of hope and confidence, which is quoted from the concluding lines of his acceptance address at the Willard Gibbs Medal presentation in 1931: "Step by step, one mystery of life after another is being revealed. Whether the human mind will ever attain complete and absolute knowledge of and complete mastery of life is not essential. It is certain, however, that the revolt of the biochemist against the idea of a restriction to human curiosity will continue. New discoveries in physics, in mathematics, in theoretical chemistry furnish new tools to biochemistry, new tools for the solution of old problems and for the creation of new ones. So long as life continues, the human mind will create mysteries and biochemistry will play a part in their solution."

LAWRENCE W. BASS

MELLON INSTITUTE

SCIENTIFIC EVENTS

ENGINEERING EDUCATION AT THE RENSSELAER POLYTECHNIC INSTITUTE

A NEW plan in engineering education will be put into practice at Rensselaer Polytechnic Institute this year. Through the cooperation of the General Electric Company, a large group of carefully selected students will attend for three consecutive months on the plants of the company.

This plan differs from other cooperative arrangements with industries for the education and employment training of engineering students in the fact that it permits graduation of the students within the regular four-year period, instead of making necessary an extra year in college.

The chief objection of the general cooperative plan —the extra year with its cost to the student in time and money—has been finally overcome. This will be accomplished mainly by including a classroom program to run currently in the plants with the practical experience program, and by arranging summer courses at the institute during which the students will make up what they missed in their absence. Another important feature contributing to the feasibility of this four-year plan is the fact that the outside courses will be concentrated in three consecutive months in the junior year alone rather than being split into alternating periods of several weeks each over several years.

The students selected will be juniors in the departments of mechanical engineering and electrical engineering. The courses will begin on April 1 and continue to July 1, when the students will return to the institute for the summer courses specially designed for them. Thus they will begin their senior year with three months of practical training behind them and at a time when they will be beginning to think most seriously of obtaining jobs after graduation. Much of the work of their last year can thus be interpreted in terms of what they observed in practical experience. Also they will have had three months to demonstrate and measure their abilities under the observation and counsel of prospective employers; the work of their senior year also can be interpreted and developed in terms of their discoveries in these respects. Naturally, the General Electric Company entered the plan with the hope that it would help make available men for permanent employment, but there is no employment obligation on the part of either the company or of the students. However, it is pointed out that the experience obviously would be valued by any employer.

In common with other cooperative "earn as you learn" plans, the student will receive wages while in training, thus enabling him to help pay his way through his last year. It is estimated he should save from $75 to $125 over living expenses.

EXTENSION COURSES IN AERONAUTICAL ENGINEERING OF CORNELL UNIVERSITY

IN cooperation with the Federal Government's program for national defense, Cornell University opened in Buffalo on October 7 an extension center giving advanced training in aeronautical engineering to employees of the aircraft industry. Unlike some programs set up by other institutions, under which employees must leave their jobs for a time to attend school, the Cornell plan will bring the faculty to the industries and give courses after working hours, so that production will not be curtailed at this critical time. These courses are the first ever given away from the university by the College of Engineering.

A staff from the college, under the direct supervision of Dean S. C. Hollister, will hold classes in Burgard Vocational High School, where facilities have been made available by the Buffalo Board of Education. The entire program will be financed without Federal or state funds.

Instruction will be offered especially for qualified employees of the Curtiss-Wright Corporation and the Bell Aircraft Corporation, where there has been for some time an acute shortage of aeronautical engineers. The immediate plan is to convert mechanical, electrical, civil and chemical engineers into specialists in aircraft design. Initial enrolment will be approximately 160 students, with the prospect of increases in the future as the companies expand their organizations to handle defense orders from the government. An additional order for Curtiss-Wright planes to be built in Buffalo and St. Louis plants at the cost of $94,000,000 was announced recently while Dean Hollister was in Buffalo making final arrangements to start the training course.

Facing the prospect of a considerable expansion in their organizations, officials of the aircraft companies decided several months ago that it would be desirable to promote members of the present staffs if a way could be found to qualify them for more responsible positions. Most of the expansion in personnel could then take place in the lower grades. "A spontaneous solution to the problem appeared," according to the personnel director of one of the companies, "when Dean Hollister came to Buffalo to learn what Cornell University could do to help the aviation industry in national defense." The companies are supporting the program by offering inducements to qualified employees to take the work and by cooperating with the Cornell faculty in preparing courses of maximum practical benefit to those enrolled.

Among the first contingent of professors to leave Ithaca for Buffalo are Dr. Millard V. Barton, of the Sibley School of Mechanical Engineering, and Dr. Harold V. Hawkins, of the School of Civil Engineering. Their courses will cover the action of external forces on an airplane in flight, stresses in monocoque structures, properties of airplane materials and related technical subjects. Classes will run throughout the year, meeting four nights a week.

The Cornell plan, designed to fill a specific need in the nation's educational program as related to defense, was prepared in cooperation with Dr. Studebaker, U. S. Commissioner of Education, and Dr. Lewis Wilson, of the Office of Education in Albany, both of whom have given it their enthusiastic support.

FELLOWSHIPS IN THE MEDICAL SCIENCES OF THE NATIONAL RESEARCH COUNCIL

FELLOWSHIPS in the medical sciences, similar to those which have been administered by the Medical Fellowship Board of the National Research Council since 1922, will again be available for the year beginning on July 1. These fellowships, supported by grants from the Rockefeller Foundation to the National Research Council, are designed to provide opportunities for training and experience in research in all branches of medical science. They are open to citizens of the United States or Canada who possess an M.D. or a Ph.D. degree, and are intended for recent graduates who are not yet professionally established.

In addition to these fellowships the Medical Fellowship Board announces two new groups of research fellowships, made available through a grant from the National Foundation for Infantile Paralysis, Inc. The first group, open to applicants who hold either the Ph.D. or M.D. degree, is for the purpose of providing opportunities for special training and experience in the study of filtrable viruses. The second group, open only to graduates in medicine who have completed one or more years of hospital experience in clinical surgery and are planning a career in orthopedic surgery, is designed to provide opportunities for training and research in those basic medical sciences which will be of particular value in furthering progress in the field of orthopedic surgery.

Fellows will be appointed at a meeting of the Medical Fellowship Board about March 1. Applications to receive consideration at this meeting must be filed on or before January 1. Appointments may begin on any date determined by the board.

For further particulars, address the Secretary of the Medical Fellowship Board, National Research Council, 2101 Constitution Avenue, Washington, D. C.

THE MIDWEST WILDLIFE CONFERENCE

THE sixth annual Midwest Wildlife Conference will be held at Urbana on November 14, 15 and 16. Under the direction of T. H. Frison, chief of the Illinois Natural History Survey, which this year sponsors the conference, a program is being formulated that includes as speakers well-known wildlife technicians and zoologists from the East as well as from the Midwest.

The meeting will open with a general session in which Rudolf Bennitt, of the University of Missouri, will lead a panel discussion on the unification of conservation practices. Participating in the panel will be Aldo Leopold, of the University of Wisconsin; Charles G. Sauers, of the Forest Preserve District of Cook County, and other conservationists. The panel will be followed by two sessions running concurrently, one on fish and the other on waterfowl, upland game and furbearers. Special clinics on deer and prairie chicken are planned.

On the program for the second day are three concurrent sessions, one on fish, one on waterfowl and a third on upland game and furbearers. New features of the conference are two sessions of a non-technical nature, one for waterfowl hunters and the other for fishermen and upland game hunters, at which wildlife technicians will speak informally and answer questions put to them by the attending sportsmen.

Chairmen of the sessions include Ira N. Gabrielson, director, U. S. Fish and Wildlife Service; Walter H. Chute, director, John G. Shedd Aquarium, Chicago; Warren W. Chase, regional director, U. S. Soil Conservation Service; Arthur D. Hasler, department of zoology, University of Wisconsin, and Miles D. Pirnie, director, Kellogg Bird Sanctuary, Battle Creek, Michigan. H. H. Bennett, director of the U. S. Soil Conservation Service, will address the conference at the annual banquet on November 14.

As already reported in SCIENCE the Natural Resources Building, the new home of the Illinois Natural History Survey and the Geological Survey, on the south campus of the university, will be dedicated on November 15. The Geological Survey is sponsoring a conference on coal, oil, gas and industrial minerals, and will join the Natural History Survey in the dedication ceremonies. Participating will be representatives of the Federal and State Governments, through which construction funds were provided, and of cooperating universities, research institutions and industrial organizations. The dedication address of Dr. Isaiah Bowman, president of the Johns Hopkins University, will be followed by a reception in the new building and by a banquet in the evening.

Originating at Urbana in 1935, the Midwest Wildlife Conference has annually since that time assumed increased importance among wildlife technicians of the central part of the country. States usually represented, in addition to Illinois, are Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio and Wisconsin. This year, Kansas and Oklahoma will send wildlife technicians to take part in the special clinic on prairie chickens planned for November 14.

AWARD OF THE WILLIAM H. NICHOLS MEDAL OF THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY

DR. LINUS PAULING, head of the division of chemistry and chemical engineering of the California Institute of Technology, has been awarded the William H. Nichols Medal for 1941 of the New York Section of the American Chemical Society, according to an announcement made by Professor Arthur W. Hixson, of Columbia University, chairman of the medal jury.

Dr. Pauling is cited "for his distinguished and pioneer work on the application of quantum mechanics to chemistry and on the size and shape of chemical molecules." The presentation will be made at a dinner of the section on March 7, at which time he will deliver the annual address of the Nichols medallist. The official statement by the jury giving the grounds for which the award was made reads:

> Dr. Pauling has profoundly influenced the whole of chemical thought. His study of "The Nature of the Chemical Bond," appearing last year, was acclaimed by critics as the most valuable work on molecular structures in relation to chemistry published for a number of years. It excited more interest and enthusiasm than any treatise on a specialized topic in chemistry since Gilbert N. Lewis and Merle Randall, of the University of California, published their "Thermodynamics" in 1923.
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> Dr. Pauling has pioneered in applying quantum mechanics to chemistry. He has done much to explain the manner in which atoms are linked together to form molecules and why certain atoms react and combine differently under different circumstances. His contributions have been technical as well as theoretical. He has developed methods of testing conclusions drawn from theoretical study, and means of measuring the size and shape of molecules.
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> Because of the chemical rules which have been formulated by Dr. Pauling, chemists are able to predict the reaction of certain molecules under various conditions. His work applies equally to organic, biological and inorganic chemistry. He has shed light on the shape and activity of the protein molecule. By using actual experimentation to check his theoretical explanations of the manner in which atoms in the protein molecule must combine, Dr. Pauling has eliminated a number of hypotheses concerning the shape of the molecule.
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> It was Dr. Pauling who discovered that a radius of activity could be assigned to each atom; that is, there is a definite amount of space "filled" by each atom with its force. Adjacent carbon and oxygen atoms are therefore usually at a set, determinable distance apart. When this distance varies it is an indication of some force exerting influence. Dr. Pauling has originated methods of accounting for such forces and consequently of explaining in part some of the erratic properties of atoms.
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> Dr. Pauling has been responsible for the application of the resonance phenomenon to chemistry. This phenomenon accounts for the attraction and repulsion that atoms have for one another, and also in part for the manner in which atoms bind together to form molecules. It aids in explaining valence bonds, the links between atoms.

SCIENTIFIC NOTES AND NEWS

DR. JAMES EWING, emeritus professor of pathology at the Cornell University Medical School and formerly director of Memorial Hospital for the treatment of cancer and allied diseases, was presented with the fourth Clement Cleveland Medal of the New York City Cancer Committee at a dinner given on October 30 in the National Arts Club. The medal was awarded for "outstanding work during the year in the campaign to control cancer."

FOR his article entitled "The Surface of the Nearest

Star," printed in the *Journal* of the Society of Motion Picture Engineers, Dr. Robert R. McMath, director of the McMath-Hulbert Observatory of the University of Michigan, was presented with the Journal Award of the society at the banquet held at the recent annual meeting at Hollywood, California.

MEDALS for distinguished service to China were presented on October 25 on behalf of the Chinese Government by Dr. F. C. Yen, formerly Chinese National Health Administrator, to eleven directors of the American Bureau for Medical Aid to China. Among those who received medals are Dr. James B. Murphy, member of the Rockefeller Institute for Medical Research in charge of cancer research; Dr. George Morris Piersol, professor of medicine in the Graduate School of Medicine of the University of Pennsylvania and medical director of the Bell Telephone Company of Pennsylvania; Dr. Homer W. Smith, professor of physiology, and Dr. George B. Wallace, professor of pharmacology, both of the New York University College of Medicine.

DR. T. HARPER GOODSPEED, director of the botanical gardens of the University of California, has been elected to honorary membership in the Santa Barbara Botanic Garden.

A MEDAL has been established by the Royal Astronomical Society of Canada to be awarded annually for work by amateur astronomers. It will be known as the Chant Medal, in honor of Dr. C. A. Chant, director emeritus of the Dunlap Observatory of the University of Toronto and a past president of the society. It is hoped to make the first award next January. The medal will be of silver and will be three inches in diameter.

Nature states that the following are serving as officers of the Society of Chemical Industry for 1940–41: *President,* Professor J. C. Philip; *Honorary Treasurer,* Dr. L. H. Lampitt; *Honorary Foreign (or Overseas) Secretary,* Dr. Wm. Cullen; *Chairman, Bureau of Chemical Abstracts,* Dr. L. H. Lampitt; *General Secretary,* H. J. Pooley, Clifton House, Euston Road, London, N.W.1.

DR. L. C. KNIGHT, professor of mathematics at the College of Wooster, has retired after thirty-two years of service.

DR. JOHN EVERETT GORDON, professor of preventive medicine and epidemiology at the Harvard Medical School and director of the new Harvard public health unit and the Harvard-Red Cross Hospital in England, has been appointed to succeed the late Dr. Hans Zinsser as Charles Wilder professor of medicine and epidemiology.

DR. HERBERT A. YOUNG, assistant professor of chemistry at the College of Agriculture at Davis of the University of California, has been appointed acting chairman of the department of chemistry to fill the vacancy left by the death of Professor C. S. Bisson.

LEONARD W. MAYO, chairman of the Westchester, N. Y., County Council of Social Agencies and president of the Child Welfare League of America, has been appointed dean of the School of Applied Social Sciences of Western Reserve University. Mr. Mayo will take up the work of associate dean and professor of social administration in January and will succeed Dr. J. Elbert Cutler as dean in June.

PROMOTIONS in the School of Medicine of Western Reserve University include Dr. Claude S. Beck, who has been made professor of neurosurgery, and Dr. John A. Toomey, who has been appointed professor of clinical pediatrics and contagious diseases.

DR. L. DAVID HINER, of the department of pharmacy of the South Dakota State College, has been appointed professor of pharmacy at the Ohio State University.

DR. LAURENCE H. SNYDER, of the Ohio State University, will be visiting professor of medical genetics at the Medical School of Duke University during the winter quarter of 1941. While there he will also lecture on medical genetics at the University of North Carolina and at Wake Forest College.

PROFESSOR GEORGE POLYA, who has been at the Technische Hochschule in Zurich for two years, has joined the staff of the department of mathematics at Brown University.

DR. JAMES R. SCOTT, professor of health education at the University of New Mexico, has been appointed state director of public health of New Mexico. He succeeds Dr. Edwin B. Godfrey, of Santa Fe, who resigned several months ago.

ACCORDING to the *Journal* of the American Medical Association, Dr. James F. Worley, senior surgeon, U. S. Public Health Service, medical director of the Alaska division of the Indian Medical Service, Juneau, has been transferred to Minneapolis as medical director of district Number 1, comprising the states of Michigan, Wisconsin, Minnesota, Iowa, Nebraska and North and South Dakota.

DR. WILLIAM C. MEYER, professor of astronomy at the University of California at Berkeley, has been appointed associate director of relations with schools for the university. Dr. Hiram W. Edwards, who is director, will continue to work at Los Angeles, and Dr. Meyer will supervise activities in the northern part of the state.

DR. C. I. BLISS, of Sandusky, Ohio, has been appointed biometrician in the Agricultural Experiment Stations at New Haven and at Storrs, Conn. For the present he will work on a half-time basis. During the remainder of the year he plans to continue his work as consulting biometrician at various institutions.

Since July 1, 1939, the Rockefeller Foundation has supported a research program on molecular spectra at the University of Chicago under the direction of Professor Robert S. Mulliken, with the cooperation of Dr. Hans G. Beutler. Dr. Lyle W. Phillips, research assistant the first year, has accepted a position as instructor in physics at the University of Illinois. Dr. Anthony Turkevich is now research assistant. Dr. Carol A. Rieke has continued as research assistant in charge of computation. Dr. Stanilaus Mrozowski, formerly docent in physics at the University of Warsaw, has recently become a research fellow.

Professor Frank H. Smith, of the department of engineering of the University of Michigan, has leave of absence for a year to serve with the ordnance department of the U. S. Army.

It is stated in the *Journal* of the American Medical Association that a medical subcommittee of the Committee to Defend America by Aiding the Allies, of which William Allen White, editor of the Emporia, Kansas, *Gazette*, is chairman, has been formed. The subcommittee urges physicians to enroll in local branches of the main committee, to send letters and telegrams to congressmen and presidential candidates stressing the need for all possible aid to Britain and to send contributions to the national committee. Members of the subcommittee are Drs. Emile Holman, Eugene S. Kilgore and Ray Lyman Wilbur, San Francisco; Roger I. Lee, Boston; Warfield T. Longcope, Baltimore; John H. Musser, New Orleans, and Dallas B. Phemister, Chicago.

Dr. Carl D. LaRue, of the department of botany, has leave of absence for the first semester from the University of Michigan to study rubber cultivation in Bolivia.

Dr. Hermann J. Muller has accepted the invitation of Amherst College to work in the department of biology as guest investigator during the academic year 1940–41. Dr. Muller has been a member of the staff at the Institute of Animal Genetics at Edinburgh for the past two years. He recently returned to the United States, as work in genetics has been discontinued in Scotland because of the war. Dr. Muller will continue his work on gene mutation and chromosome breakage in Drosophila at Amherst.

Dr. B. Gottlieb, formerly director of the histologic laboratory of the Dental School of the University of Vienna, is now on his way to the United States. He will be associated with the Dental School of the University of Michigan.

The New York Herald Tribune's tenth annual Forum on Current Problems, organized under the general subject, "America's Second Fight for Freedom, 1776–1940," was held on October 22 at the Waldorf-Astoria Hotel. Among the speakers in the second session, entitled "Science and Industry Mobilize," were Professor Harlow Shapley, director of the Harvard Observatory; Dr. W. F. G. Swann, director of the Bartol Research Foundation of the Franklin Institute, and Dr. Harold C. Urey, of Columbia University.

Dr. Charles Armstrong, senior surgeon of the U. S. Public Health Service, National Institute of Health, Washington, D. C., delivered the first Harvey Society Lecture of the current series at the New York Academy of Medicine on October 31. He spoke on "Studies on Lymphocytic Choriomeningitis and Poliomyelitis."

The Western Society of Naturalists will meet at the University of California at Los Angeles on December 18, 19 and 20. Two symposia have been arranged; one on "Training for Research and Instruction in the Biological Sciences," and the other on "Perspective in Marine Biology." In addition a number of scientific papers will be presented. Professor Wesley R. Coe, of Yale University, will make an address at an evening smoker on December 18.

James Stokley, of Science Service, gave on October 22 the first Francis Bergen Memorial Lecture of the 1940–41 season at Yale University. His subject was "Astronomical Adventures."

Dr. Arnold L. Gesell, professor of child hygiene at Yale University, will give an address entitled "The First Five Years of Life" at the annual meeting of the Massachusetts Society for Mental Hygiene, which will be held at the Twentieth Century Club, Boston, on November 21.

The fifty-sixth annual autumn meeting of the Indiana Academy of Science will be held from November 14 to 16 at Muncie, with the Ball State Teachers College as the host institution. Frank N. Wallace, state entomologist, will preside. An attendance of about five hundred is expected.

The registered attendance at the sixty-ninth annual meeting of the American Public Health Association and meetings of related organizations held in Detroit during the week of October 7 was 3,187. Delegates came from every state in the Union, the District of Columbia, Alaska, Hawaii, Puerto Rico, Canada, Cuba, Mexico, Denmark, China and New Zealand. The officers elected for the year 1940–41 are as follows: *President:* W. S. Leathers, Nashville; *President-*

elect: John L. Rice, New York; *Vice-president:* Robert D. Defries, Toronto; *Vice-president:* Charles Edward Finlay, Havana; *Vice-president:* Selskar Gunn, New York; *Treasurer:* Louis I. Dublin, New York; *Chairman of the Executive Board:* Abel Wolman, Baltimore; *Executive Secretary:* Reginald M. Atwater, New York. A Committee on Public Health in the National Defense was appointed with the following personnel: W. S. Leathers, chairman, Stanley H. Osborn, Huntington Williams and Abel Wolman. Among the resolutions passed was one emphasizing the necessity for maintaining civilian health as essential to national defense and pledging the united support of members to national defense and to the maintenance of health in a free people. The seventieth annual meeting will be held in Atlantic City, N. J., in October, 1941.

THE School of Mathematics of the Institute for Advanced Study each year allocates a small number of stipends to gifted young mathematicians and mathematical physicists to enable them to study and to do research work at Princeton. Candidates must have given evidence of ability in research comparable at least with that expected for the degree of doctor of philosophy. Blanks for application may be obtained from the School of Mathematics of the Institute, Fuld Hall, Princeton, N. J., and are returnable by February 1, 1941.

ANNOUNCEMENT has been made by the Finney-Howell Research Foundation, Inc., that applications for fellowships for next year must be filed in the office of the foundation, 1211 Cathedral Street, Baltimore, Md., by January 1. This foundation was provided for in the will of the late Dr. George Walker, of Baltimore, for the support of "research work into the cause or causes and the treatment of cancer." The will directed that the surplus income from the assets of the foundation together with the principal sum should be expended within a period of ten years to support a number of fellowships in cancer research, each with an annual stipend of two thousand dollars, "in such universities, laboratories and other institutions, wherever situated, as may be approved by the board of directors." Fellowships are awarded for the period of one year, with the possibility of renewal up to three years; when deemed wise by the board of directors, special grants of limited sums may be made to support the work carried on under a fellowship.

THE new session of the faculty of medical science of King's College, London, located until lately at Glasgow, opened at the medical school of the University of Birmingham on October 9.

DISCUSSION

MULTISENSUAL MATHEMATICAL TERMS

MATHEMATICS belongs to the many smaller, but now very active, scientific laboratories of the lexicographers. In a paper by H. Poincaré (1854–1912) read at the Fourth International Congress of Mathematicians, held at Rome, Italy, in 1908, it is asserted that mathematics is the art of giving the same name to different things. Hence the use of multisensual terms in mathematics is not exceptional even if it requires that the reader select meanings when he may not be in position to decide wisely. In very early times mathematics devloped in part a special language, as may be seen in the ancient Babylonian algebraic writings which have only recently been deciphered by O. Neugebauer and others. In one of the most influential medieval mathematical books called "Summa" (1494) its author, L. Pacioli, seriously asked the question whether it is not a contradiction to say that when we multiply by a number which is less than unity the product is less than the multiplicand, since the Bible uses the term "multiply" to mean increase.

In more recent times the mathematicians have greatly extended the use of the term "multiply" by not only multiplying by negative and complex numbers but also by multiplying where no numbers at all are involved, as in the case of group operations where the term is used simply to denote the combination of elements and is sometimes used interchangeably with adding. In the ancient mathematical literature the omission of a symbod of operation between two elements commonly implied addition, but since medieval times it more commonly implies multiplication. While multiplication at first implied only a special kind of addition, *viz.*, the case when the addends are equal to each other, it has assumed during the ages meanings which have little in common with this original meaning and the lexicographers would probably find it impossible to furnish a satisfactory explanation of these elementary extensions of meanings.

Among the many instances of mathematical terms which have become multisensual much more recently than the term multiplication we may mention the term group, which is one of the many simple English words whose mathematical meaning has become difficult and is now often misunderstood even by writers on mathematical subjects. As a technical term it was introduced by a young Frenchman, E. Galois (1811–1832), who was practically unknown at the time of his early death, but whose reputation has grown since then and is now one of the greatest among the comparatively small galaxy who became known solely on account of their mathematical ideas whose fruitfulness was developed by their successors. At first this term had a very simple meaning, representing merely a set of distinct permutations which have the property that they include the product of every two of them and the square of every one. Surely this is not a difficult concept for the human race to acquire explicitly as late as the first half of the nineteenth century.

The difficulty among mathematicians began to exhibit itself when, about fifty years after this technical term was introduced, efforts were made to define it abstractly and to base an abstract theory on it. This theory became elegant and useful, but it created a kind of strait-jacket which seemed to interfere with the freedom of action which many mathematicians enjoy, and it naturally curbed productivity even if it did not create a barrier thereto. A central idea of this abstract theory is that the associative law must be obeyed when the elements of a group are combined. In neither of two recent large general dictionaries of the English language, *viz.*, Webster's "New International Dictionary" (1938) and the "New Standard Dictionary" (1938) is the associative law made a definite part of the definition of the mathematical term group, notwithstanding the fact that one could not construct by means of the definitions which they give an extensive and useful abstract theory of groups.

In a recent book entitled "Premières leçons sur la théorie générale des groupes" (1935) G. Bouligand asserted (page 5) that with each mathematical proposition there is associated hereafter a group composed of all the modifications leading from one case of exactitude to a new case of exactitude. This is perhaps the vaguest and most objectionable definition of the term group that has ever appeared in a text-book and exhibits how far this particular mathematical term has wandered during a century from its first simple definition. With various other sciences mathematics is creating a kind of Tower of Babel with too few common terms besides the Ph.D. degree. It should be emphasized that the multisensual terms are even more confusing than the multitude of terms since the former frequently make it necessary to select from an ever growing list of concepts which may vary widely, while dictionaries are more apt to clarify the latter.

G. A. Miller

University of Illinois

HOLLY DEFOLIATION PREVENTED BY a-NAPHTHALENEACETIC ACID[1]

a-Naphthaleneacetic acid has received considerable attention since Gardner, Marth and Batjer[2] reported its value in preventing fruit drop in apples. Another use for this chemical that promises to be of value to holly growers has been found at the Oregon State Experiment Station. The defoliation of holly sprays and wreaths during shipment at Christmas time often results in large losses. Spraying or dipping holly in a-naphthaleneacetic acid previous to shipment offers a method to prevent this loss.

Previous work at the Oregon Experiment Station has shown that holly is defoliated either by the presence of ethylene gas or high humidity. In the present experiments the holly was subjected to both ethylene gas and high humidity, but some of the lots were previously sprayed with solutions of a-naphthaleneacetic acid, and others were sprayed with water. Branches of holly (*Ilex aquifolium*) were sprayed and then placed in jars with apples as the source of ethylene gas. Free water was present on the sides and bottom of the jars. In 48 hours the holly sprayed with water alone was completely defoliated. The leaves began to drop from holly sprayed with .001 per cent. of a-naphthaleneacetic acid in 48 hours, but defoliation was not completed for 144 hours. The holly treated with .005 per cent. did not begin to defoliate until after eight days, and complete defoliation occurred in ten days. The leaves were firmly attached on the holly sprayed with .01 per cent. a-naphthaleneacetic acid after fourteen days. Later this lot of holly turned black and decayed without shedding its leaves. The severity of this test is evidenced by the complete defoliation of the untreated lot of holly in 48 hours. Other sprayed and unsprayed lots of holly were packed in wet paper, and these were held at 75–85 degrees for one week. Defoliation had occurred on all unsprayed lots of holly, but those sprayed with .01 per cent. a-naphthaleneacetic acid had all their leaves firmly attached at the end of the experiment.

J. A. Milbrath
Henry Hartman

Oregon State College

ONCOMING REVERSAL OF THE HUMAN GROWTH TIDE

Recent completion of a study of height, weight and menarchial records for over 65,000 freshmen, matriculating in four state universities in recent years, has shown that the reversal in the human growth tide hinted at in 1938[1] is now becoming more definite. The mean age for onset of the menses, which for many years had been coming progressively earlier with successive birth years of freshman girls, has now reversed its trend. At the Women's College of the University of North Carolina, freshman girls born since 1918 have shown a later mean menarchial age for each successive birth year (1939–40 entering class not included). At the University of Kansas and at Cincinnati the reversal came with those born in 1920, while at the University of Wisconsin it was shown by those born in 1922 and by the whole entering class of 1939–40. While the actual changes in menarchial age are still small and not mathematically significant, the coincidental reversal in trend in all the states studied, after a number of years of steady progress toward earlier menarche, lends emphasis to the likelihood that a real biologic change is taking place.

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[1] Published as Technical Paper No. 355 with the approval of the Director, Oregon Agricultural Experiment Station. Contribution of the Departments of Botany and Horticulture.

[2] Science, n. s., 90: 2331, 208–209, 1939.

[1] C. A. Mills and L. B. Chenoweth, *Human Biol.*, 10: 547–554, 1938.

The upward trend in student stature, so commonly remarked about and attributed to a better dietary, also shows evidence of reversal in the more southerly states. The accompanying figure indicates the height-weight changes that have taken place among freshmen entering the state universities of Kansas, Kentucky and North Carolina (Women's College only). A steadily progressive, although slight, decline in male height has occurred since the entering classes of 1932. Height of the girls showed a decline from the entering class of 1934 to that of 1937, with a sharp recovery in the 1938 entering classes. Farther north, at the University of Wisconsin, gain in freshman stature is still progressing. Wisconsin freshmen are about 4 pounds heavier and the boys 1.0 inch taller (the girls only 0.1 inch) than are freshmen in states of lower latitudes.

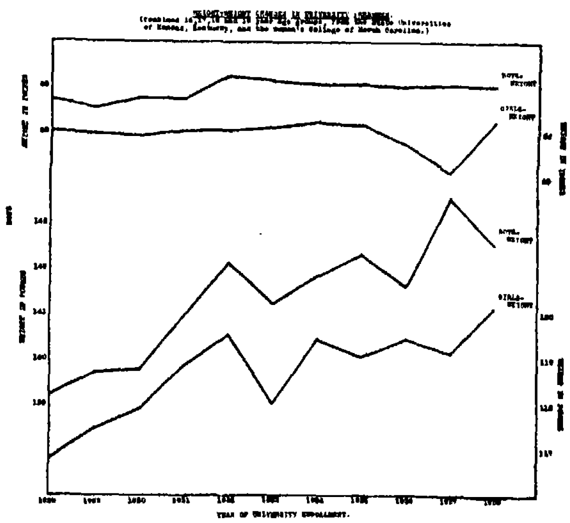

FIG. 1

Improvement in both height and weight with succeeding classes has been limited largely to gains in the younger age groups of each class, with stature stabilization in the older freshmen of recent years. It appears, therefore, that adult stature may well actually be receding at lower latitudes in the United States, while more rapid growth through childhood and adolescence continues to bring young people to adult stature at ever earlier ages. Even back among students in the early years of high school, this annual stature improvement at a given age is clearly evident. Signs of stabilization have appeared here also in age groups from 13 years upward, while marked annual gains still occur in the stature of any younger age group.

Since we have already shown a clear-cut relationship between the growth and onset of sexual activity in animals and their environmental temperature level or ease of body heat loss,[2] it is suspected that cessation or reversal in the human growth tide may be due to the almost continuous unseasonable warmth that has prevailed generally over the earth since 1929, except for a few very brief periods of subnormal temperatures. Both height and weight of Cincinnati high-school students of given age groups showed distinct regression from previously prevailing levels following the very severe heat of 1934.

Certainly this cessation or reversal in the growth tide can not be related to any increasing dietary inadequacy here in America among families sending children to college. The dietary of this class of people in America has probably never been better than it is to-day, especially in the wide availability of fresh fruits and vegetables at all seasons of the year. If human development *is* affected by changes in prevailing temperature level (as that of laboratory animals has been shown to be) then we may well be deeply concerned with the prospects of long-term climatic changes. The marked physical recession of mankind during the Dark Ages occurred during centuries of world warmth, while the recent racial growth expansion has come with generally lower temperatures. Earth temperatures have been trending upward again now for over eight decades, but perhaps reaching the critical level necessary to produce growth depression only with the markedly abnormal warmth that has prevailed since 1929.

From the standpoint of general racial biology, it would seem important that astronomers and climatologists direct more systematic and intensive investigations into the causative background of world weather and longer-term changes in temperature level. Weather has ceased to be merely a subject for conversational pleasantry. It is rapidly coming to be appreciated as one of the really major forces dominating man's existence.

C. A. MILLS

UNIVERSITY OF CINCINNATI

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[2] C. A. Mills, "*Medical Climatology*," Springfield: Charles C Thomas, 1939.

WIDER USE FOR ACADEMY OF SCIENCE PUBLICATIONS THROUGH IMPROVED DISTRIBUTION

IN these days of crowded scientific journals the question may well be raised whether papers published by State and local academies of science receive adequate and efficient distribution. Most of these academies are time-honored institutions born in the days when natural historians discoursed on any phase of nature that happened to come to their attention. The journals of the societies were originally of broad scope and stressed the natural science of the State or locality rather than any particular field of knowledge. Much the same tradition continues.

Conditions now are vastly different. Increase in human knowledge and improvement in transportation have shifted scientists to association more by subject than by locality. A paleontologist working in New York, for example, now finds a paleontologic discovery in Alabama more vital to him than a botanical problem in his own county. True, constant contact with developments in other sciences is needed, but broad general articles of the sort appearing in SCIENCE more nearly fill this need than do the detailed studies commonly published in academy journals or transactions.

Much of the material published by academies and circulated to members is permanently shelved or even discarded because it pertains to fields in which the recipient has no immediate interest. These same articles, however, would be valued highly by workers in other areas who subscribe only to publications of their local societies. Printing of articles as separates and requiring the subscriber to indicate the publications wanted can avoid some of the waste, but will not always provide sufficiently wide dissemination of knowledge.

Is it not time for groups of academies, particularly those affiliated with the American Association for the Advancement of Science, to develop means of exchanging publications among their various members? Botanists, in a group of four cooperating academies of similar size and neighboring locations, for example, could receive the botany papers of all four societies unless they had definitely given some other preference. Paleontologists could elect geology or zoology options or some prearranged grouping suitable to their needs. As an alternative all members could select articles totaling a predetermined maximum number of page units—highly illustrated papers perhaps being given a higher page unit rating. In this way a greater proportion of academy of science publications would reach the hands of those who would value and use them, and fewer would be lost on unused shelves or filed in the waste basket. Academy memberships would be increased because of the greater return to the members.

For library use, the complete publications of each academy of science could still be bound and shelved together.

C. F. STEWART SHARPE

SOIL CONSERVATION SERVICE,
NEW PHILADELPHIA, OHIO

SOCIETIES AND MEETINGS

THE TUCSON MEETING OF THE SOUTHWESTERN DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE twentieth annual meeting of the Southwestern Division of the American Association for the Advancement of Science and of four associated societies was held at Tucson, Arizona, during the week of April 22, 1940. The associated societies were the clearing house for Southwestern Museums, the Southwestern Section of the Mathematical Association of America, the Southwestern Section of the Society of American Foresters and the Society for American Archeology.

Considering the great distances and the small number of educational institutions in this area, with less than four hundred members of the American Association for the Advancement of Science, the registration of 176 may be regarded as very good.

Five organizations joined in sponsoring the meeting and served as hosts to the visiting members and guests. They were the University of Arizona, the Desert Sanatorium of Southern Arizona, United States Coast and Geodetic Survey Magnetic Observatory, United States Southwestern Forest and Range Experiment Station and United States Department of Agriculture Soil Conservation Service.

It was the third meeting in Tucson. Southern Arizona, rich in historic background, has much to offer in the fields of interest represented in the division. All sessions were held on the campus in the commodious buildings of the University of Arizona, making it a simple matter to go from one section to another. The very spacious cactus garden on the campus was in its glory at that season and added to the pleasure of the visit to Tucson. Those going to and from Tucson by auto were also given a rare treat while traveling through the extensive desert cactus forests, all in full bloom.

The local arrangements were in charge of a general committee, headed by Dr. E. W. Haury, department of anthropology, University of Arizona, Tucson. The committee, with the aid of various local and governmental agencies, provided visitors with a wealth of entertainment, including an informal reception on Monday afternoon at the home of President and Mrs. Atkinson, of the university.

During the week, visits were offered the scientists and their guests to the Arizona State Museum, the Arizona Pioneers' Historical Society Museum, the Tree-Ring Laboratory, the Geology Museum, the Papago Indian Arts and Crafts Board exhibit and demonstration of basketry, pottery and leather work, and the Steward Observatory, all on the campus. The Desert Sanatorium, five miles northeast of Tucson, held open house on Tuesday, as did the United States Coast and Geodetic Survey Magnetic Observatory, seven miles east of Tucson, on Wednesday afternoon.

On Thursday, special excursions of a more extensive nature were organized for persons interested in the biological, physical and social sciences. Biologists enjoyed one or more of the following trips: U.S.D.A. Soil Conservation Service Nursery, native and introduced grasses; Sahuaro National Park, giant cactus; Tucson Mountain Park Area; Santa Rita Range Experiment Station, and University of Arizona Farm. The physical scientists chose from the following: Picacho de Calera Hills, paleontology; Tucson Mountains, overthrust fault; Catalina Mountains (Sabino Cañon), metamorphism.

The social scientists were given an opportunity to visit Ft. Lowell, San Xavier Mission, Tumacacori National Monument Mission, University Indian Ruin, Casa Grande National Monument, Snaketown, excavations of Amerind Foundation near Benson, and Amerind Foundation Museum at Dragoon.

The meeting started with a general session on Monday morning, when a welcoming address was given by President Alfred Atkinson, of the University of Arizona, to which Dr. J. R. Eyer, department of biology, New Mexico College of Agriculture and Mechanic Arts, State College, and president of the Southwestern Division of the American Association for the Advancement of Science, responded. Monday evening was devoted to the annual Sigma Xi banquet, held in the ballroom of the Pioneer Hotel, followed immediately by the Sigma Xi lecture, given by Dr. Harold S. Colton, director of the Museum of Northern Arizona, at Flagstaff. Dr. Colton's lecture, which was thrown open to the public, was profusely illustrated, and dealt with "Prehistoric Trade in Arizona."

Tuesday, in addition to the section meetings, was given over to group luncheons for the "Clearing House for Southwestern Museums" and for "Mathematicians and Friends." Professor S. B. Talmage, department of geology and mineralogy, New Mexico School of Mines, Socorro, spoke to the latter group on "Evolution, Plus and Minus." The annual banquet held in the ballroom of the Pioneer Hotel was attended by about one hundred persons. It was followed by a public address by retiring president, J. R. Eyer, New Mexico College of Agriculture and Mechanic Arts, State College, on the "Responsibility of the Scientist in a Changing World Order." Mu Alpha Nu, honorary anthropological fraternity, sponsored a luncheon for members and friends on Wednesday at noon.

The annual business session of the division was held on Wednesday afternoon, at which time Dr. C. V. Newsom, department of mathematics, University of New Mexico, Albuquerque, was elected to the presidency of the Southwestern Division, and Dr. William M. Craig, department of chemistry and chemical engineering, Texas Technological College, Lubbock, was elected vice-president, for the year 1940–41. Dr. Frank E. E. Germann, department of chemistry, University of Colorado, Boulder, was elected secretary-treasurer for an indefinite term. New members of the executive committee were Dr. J. R. Eyer, department of biology, New Mexico College of Agriculture and Mechanic Arts, State College, and Dr. H. P. Mera, Laboratory of Anthropology, Santa Fe, New Mexico, to serve until 1943, and F. H. Douglas, the Denver Art Museum, Denver, Colorado, to serve until 1941.

Officers elected by the several sections were announced as follows:

Biological Section: Chairman, Dr. Harold M. Hefley, Texas Technological College, Lubbock; *Secretary*, Alvin R. Grove, University of New Mexico, Albuquerque.

Mathematical Section: Chairman, Dr. E. J. Purcell, University of Arizona, Tucson; *Vice-chairman*, Dr. Roy MacKay, Eastern New Mexico College, Portales; *Secretary*, Dr. Harold Larsen, University of New Mexico, Albuquerque.

Physical Science Section: Chairman, Dr. F. E. Roach, University of Arizona, Tucson; *Secretary*, Dr. O. B. Muench, New Mexico Normal University, Las Vegas.

Social Science Section: Chairman, Dr. W. C. Holden, Texas Technological College, Lubbock; *Secretary*, William Pierce, Texas Technological College, Lubbock.

The 1941 meeting of the division is to be held in Lubbock, Texas; the 1942, in State College, New Mexico. It was tentatively agreed that the 1943 meeting would be held in Phoenix, Arizona.

One hundred and twenty-nine papers were presented at the section meetings. The meeting was closed, except for excursions, by the Eleventh Annual John Wesley Powell Memorial Lecture on "Activities in Plant Science," by Dr. D. T. MacDougal, of the Carnegie Institution. Although Dr. MacDougal now lives in California, he was one of the founders of the Southwestern Division, and served as president of the division in 1922. The John Wesley Powell Memorial Lectures were established in 1929, in honor of the noted explorer of the Grand Cañon of the Colorado River. Under present arrangements a lecture is delivered at each annual meeting of the division by a distinguished investigator in some field of science upon a topic of his own selection. The roll of lecturers and the fields represented are as follows:

1929. William Morris Davis, Harvard University (Geology).
1930. Rodney H. True, University of Pennsylvania (Botany).
1932. Max Pinner, Desert Sanatorium of Southern Arizona (Medicine).
1933. Aldo Leopold, University of Wisconsin (Forestry).
1934. Otto Struve, University of Chicago (Astronomy).
1935. Edgar L. Hewett, University of New Mexico (Archeology).
1936. John C. Merriam, Carnegie Institution (Paleontology).
1937. A. E. Douglass, University of Arizona (Astronomy).
1938. E. R. Hedrick, University of California, Los Angeles (Mathematics).
1939. A. H. Compton, University of Chicago (Physics).
1940. D. T. MacDougal, Carnegie Institution (Botany).

FRANK E. E. GERMANN
UNIVERSITY OF COLORADO

SPECIAL ARTICLES

A NEW TYPE OF VIRUS FROM EPIDEMIC INFLUENZA[1]

IN February and March of 1940, an epidemic of acute respiratory disease, simulating epidemic influenza, occurred at Irvington House, a convalescent home for children with rheumatic cardiac disease, located at Irvington on Hudson. Through the courtesy of Dr. Ann G. Kuttner, throat washings were received from 4 cases in the first 3 days of illness and, in addition, samples of serum were taken in the acute and convalescent stages. Neutralization tests done with these sera revealed no rise in antibody titer during convalescence against 1000 M.L.D. of the PR8 strain of the virus of epidemic influenza. Mice and ferrets were inoculated intranasally with 3 of the throat washings. Two of the ferrets failed to exhibit recognizable signs of infection and their sera, taken 8 and 51 days later, respectively, failed to neutralize the standard PR8 strain of virus. Attempts to isolate a virus directly in mice from any of the throat washings were unsuccessful through 5 serial passages at 4-day intervals or 10, 21 and 23 passages, respectively, at 7-day intervals.

The temperature of the ferret inoculated with throat washings from the third patient (Lee) fell to subnormal on the 5th and 6th days. The animal stopped eating, was abnormally quiet and had some respiratory distress. At autopsy on the 6th day the only gross finding was a mild, bluish discoloration of the left lower lobe of the lung. Passage to a normal ferret was made with a suspension of lung and turbinates and 13 serial transfers were made at 4- to 6-day intervals in this species of animal. After the 5th passage a double series was maintained. In 2 of the 20 ferrets, the highest temperature was above 105° F.; in 7, it was 104-5°; in 6, between 103.5° and 104°; in 3, no evidence of fever was obtained and in 2 the temperature was subnormal. In 13 of 18 autopsied ferrets mild pulmonary lesions, usually spotty, were noted and the majority presented abnormalities of the respiratory turbinate tissue. Serum taken from the sole convalescent ferret (B77-9th passage) on the 21st day failed to neutralize 1000 or 100 M.L.D. of the mouse passage PR8 strain of virus. Hence, by the criteria established in 1937[2] this outbreak of respiratory disease was not associated with the virus of epidemic influenza.

Groups of mice were inoculated intranasally with suspensions of lung, turbinate or both from ferrets of the 5th, 7th, 8th, 9th, 10th and 13th passages and multiple transfers were made with lung suspensions by the intranasal route at 4- to 6-day intervals. Using 40 per cent. suspensions, only small lesions were as a rule observed in mice of the first 5 passages. Thereafter, an increase in severity of the disease occurred so that by the 10th transfer infections were frequently fatal within the 5-day period. With continued passage the virulence increased so that at present virus of the two series which have been continued through 40 passages produces *fatal infection within 10 days* when used in a 1:1000 dilution, occasionally 1:10,000, of infected mouse lung.

Throughout its development the lesions produced by the virus in the lungs of mice have been of the uniform reddish blue type seen in infections with the virus of epidemic influenza. Nevertheless, when tested against rabbit or ferret serum prepared against numerous different strains of epidemic influenza virus, no neutralization of 200 M.L.D. or less of the Lee virus was effected. It was not neutralized by rabbit sera prepared against several strains of poorly defined agents, probably of mouse origin, or by serum against normal mouse virus obtained from Dr. F. L. Horsfall, Jr. (Table I). On the other hand, rabbit serum prepared against one passage strain of the Lee virus completely neutralized 3 substrains established in mice with material from 3 different ferret passages (8, 8A, 13A). It was then found that the convalescent serum of ferret B77, which had failed to neutralize the PR8 strain, completely neutralized the Lee strain. The virus transferred in mice and ferrets appeared therefore to be identical.

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[1] This study was assisted by grants from the International Health Division of the Rockefeller Foundation and from the Lederle Laboratories.

[2] T. Francis, Jr., T. P. Magill, E. R. Rickard and M. D. Beck, *Am. Jour. Pub. Health*, 27: 1141, 1937.

TABLE I

COMPARATIVE SEROLOGICAL TESTS WITH EPIDEMIC INFLUENZA VIRUS (PR8) AND NEW VIRUS (LEE)

Animal	No.	Immunized with virus strain	Neutralization of 100 M.L.D.	
			Influenza virus (PR8)	Lee virus
Ferret	A7	PR8	+	0
"	1199	PR8 (hyperimmune)	+	0
"	1301	Swine	0	0
"	B66	Normal	0	0
Rabbit	N3	PR8 (hyperimmune)	+	0
"	N41	PR8	+	0
"	N47	WS	±	0
"	317	WS	0	0
"	204	Mel	+	0
"	299	BH2	+	0
"	302	Tal	+	0
"	330	B15	+	0
"	240	Mo5	+	0
"	241	NY2	0	0
"	226	Phila	+	0
"	214	Smithb	+	0
"	259	TF	+	0
"	327	Henry	+	0
"	N54	Lee	0	+
FOLLOWING RECEIVED THROAT WASHINGS OF PATIENTS OR PASSAGES THEREFROM				
Ferret	B32	Duke no. 7	0	+
"	B45	Duke no. 2	0	+
"	B46	Duke no. 5	0	+
"	B52	Irv. no. 1	0	0
"	B53	Irv. no. 2	0	0
"	B77	Irv. no. 3 (Lee)	0	+

The sera of the Irvington House patients which had exhibited no rise in convalescent titer against the standard PR8 strain were tested against a 10 per cent. mouse lung suspension (100 M.L.D.) of the Lee virus. The titers of both acute and convalescent sera of patient, Lee, were approximately the same when measured against PR8. Against the Lee strain the acute titer was 0; the convalescent titer, 120. A similar result was obtained with sera of 2 others, while in one instance no difference was detected. Sera from 4 other patients who had been sick during the epidemic were fortunately available. All these also showed in convalescence a pronounced rise in antibodies to the Lee virus but not to PR8 (Table II). These results seem clearly to establish the causal association of Lee virus with the Irvington House epidemic and to demonstrate the lack of serological relationship of that virus to strains of virus isolated from other epidemics of influenza.

TABLE II

COMPARISON OF NEUTRALIZING ANTIBODIES AGAINST LEE VIRUS AND THE PR8 STRAIN OF EPIDEMIC INFLUENZA VIRUS IN SERUM FROM PATIENTS IN DIFFERENT EPIDEMICS

Epidemic	Patient	Titer of neutralizing antibodies against			
		Lee virus +		PR8 Influenza ‡ virus	
		Acute	Convalescent	Acute	Convalescent
Irvington House 1940	Lee	0	120	120	100*
	Such.	0	90	35	60*
	My.	0	0	30	30*
	Dem.	0	30	60	60*
	Tren.	0	15	0	0
	Wo.	0	120	80	80
	Cast.	0	120	280	280
	Gouv.	0	240	280	280
No. Carolina 1940	Mar.	0	60	17 (0)	17 (0)
	Sp.	0	15	8 (0)	8 (0)
	Ha.	0	120	120 (30)	120 (30)
	Led.	0	60	30 (0)	30 (0)
	Mit.	0	15	15 (0)	15 (0)
	Dav.	0	30	25 (0)	25 (0)
	Kir.	15	0	15 (0)	4 (0)
Feb., 1936 (Unidentified)	Vr.	0	240	0	0
	B. Bas.	15	240	50	50
1936–37 Influenza	Hum.	60	60	50	320
	Web.	30	50	0	35

+ Approximately 100 M.L.D. of Lee virus used.

‡ Approximately 100 M.L.D. of PR8 virus used. The sets of sera marked with asterisk or in parentheses were tested with 1000 M.L.D.

Endpoints estimated by the method of Reed and Muench.[3]

In January and February of 1940 an extensive epidemic of what appeared to be epidemic influenza extended throughout the southeastern portion of the United States. Through the kindness of Dr. D. T. Smith and members of the medical staff of Duke University Hospital, patients were made available for study. Since these investigations were undertaken toward the end of the epidemic, throat washings or sputum and serum taken during the acute and convalescent stages of illness were obtained from but 7 patients. Four of the throat washings were given intranasally to ferrets. In two instances serial passages through 4 ferrets were made. While some of the ferrets exhibited signs suggestive of infection with influenza virus, attempts to maintain the infection or to isolate a virus in mice were unsuccessful. The fourth passage ferrets (B45, B46) were bled on the 12th day; another (B32) on the 28th day. Their sera failed to neutralize the PR8 strain. Furthermore, when neutralization tests with the acute and convalescent sera of the patients were performed, using 100 and 1000 M.L.D. of the standard PR8 strain of epidemic influenza virus, no diagnostic rise in antibodies was detected. In this instance, again, the customary procedures had indicated that the virus of epidemic influenza was not involved.

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[3] L. J. Reed and H. Muench, *Am. Jour. Hyg.*, 27: 493, 1938.

In view of the studies of the Irvington outbreak, the various sera were retested against 100 M.L.D. of the Lee virus. In 6 of the 7 patients a definite rise in titer of the convalescent serum was seen (Table II). Furthermore, serum of 3 ferrets receiving throat washings from these patients neutralized the Lee virus, although they had failed to neutralize the PR8 strain. In addition, serum from 6 ferrets inoculated by Dr. Horsfall with throat washings of patients from the North Carolina epidemic were tested. Four of them neutralized the Lee virus, all failed to neutralize 100 M.L.D. of the PR8 strain. The serum of 3 patients which had been found by Dr. Horsfall to show no increased convalescent titer against the PR8 strain, when tested against the Lee virus, exhibited marked rises in neutralizing antibodies. It is evident, therefore, that the Lee virus was the cause of the earlier general outbreak in North Carolina and adjoining areas.

In the early months of 1936 a widespread epidemic of acute, respiratory disease, indistinguishable from epidemic influenza, was studied. Its etiology was not established nor was any evidence obtained relating it to known strains of the virus of epidemic influenza.[4] Sera from 2 typical patients which had been kept in storage since that time were now tested against 100 M.L.D. of influenza (PR8) and Lee viruses. Pronounced rises of titer against Lee virus occurred but not against PR8 (Table II). It appears, in consequence, that this epidemic 4 years earlier was also due to virus of the Lee type.

Reference was then made to acute and convalescent sera of 2 individuals from whom epidemic influenza virus was isolated during the epidemic of the winter of 1936–37 (Table II). Titered against the PR8 strain, rises from 0 to 35 and 50 to 320 were noted; against 100 M.L.D. of the Lee strain the acute and convalescent titers of both were approximately 60. Hence, infection of human subjects with virus of the PR8 type does not result in a rise of antibodies to the Lee virus and the difference in etiology of the epidemics is further demonstrated.

Again through the kindness of Dr. Horsfall, serum of ferrets inoculated with throat washings of patients observed in the epidemic of influenza current in the West Indies this summer were tested. Certain of these sera also neutralized the Lee virus but not the PR8.

The immunological evidence indicates clearly that the newly isolated virus is the cause of the epidemics of acute respiratory disease in Irvington and North Carolina in 1940 and of the extensive epidemic early in 1936. These epidemics have presented no outstanding clinical features to differentiate them from the outbreaks which have yielded the virus of epidemic influenza, typified by the original WS and PR8 strains. The serological studies reveal, however, that they are etiologically distinct. In fact, the lack of cross reactions between serum against known strains of influenza virus and the present virus suggests that the latter is entirely unrelated to the virus of epidemic influenza previously isolated. Complement fixation tests which ordinarily detect the common antigen of different strains of epidemic influenza virus have not yielded up to the present any helpful information. Hyperimmune PR8 rabbit and ferret sera have not neutralized even small amounts of Lee virus. Furthermore, mice vaccinated with 2 intraperitoneal injections of 5 per cent. Lee virus have died of infection with 100 M.L.D. of PR8 but staunchly resist the same amount or more of the Lee virus. The differences are clearly greater than those detected in previous studies of strains of epidemic influenza virus.[5, 6, 7] The behavior of the virus in animals and the gross pathological features are, however, quite the same as those of mild strains of known influenza virus.

The usual experience has been that human subjects infected with one strain of influenza virus produce antibodies readily detected by tests with any of the ordinary strains obtained from man, or even with strains of swine influenza virus. The absence of antibodies to the Lee virus in the serum of patients at the time of their infection and the production of specific antibodies to that virus in convalescence are independent of antibodies to the PR8 strain which remain constant during the course of this disease. It is evident, therefore, that for the purposes of differential diagnosis, the Lee virus represents a serologically distinct entity. Nevertheless, the epidemic disease associated with virus of the Lee type appears on the basis of present knowledge to be as typical of epidemic influenza as that prevalent in outbreaks from which strains of the previously recognized virus were obtained. The epidemics of 1936–37 and 1938–39 have been shown to be caused by influenza virus of the usual variety while those of early 1936 and 1940 are of the Lee type. The two infections apparently possess independent cycles, but until further differential studies are made they should both be considered epidemic influenza caused by viruses of different serological types. The isolation of the new type of virus and the accompanying serological studies have established the etiology of epidemics of acute respiratory disease simulating influenza which had previously not been identified. Following the classification recently suggested[8] in which the established form of epidemic influenza is called Influenza A, outbreaks caused by virus of the Lee type are to be designated Influenza B.

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[4] T. Francis, Jr., *Am. Jour. Pub. Health*, 27: 211, 1937.

[5] T. P. Magill and T. Francis, Jr., *Brit. Jour. Exp. Path.*, 19: 273, 1938.

[6] T. Francis, Jr., and T. P. Magill, *Ibid.*, p. 284.

[7] W. Smith and C. H. Andrewes, *Ibid.*, p. 293.

[8] F. L. Horsfall, Jr., E. H. Lennette, E. R. Rickard, C. H. Andrewes, W. Smith and C. H. Stuart-Harris, *Lancet*, 2: ——, October 5, 1940.

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THE VIBRATION OF CIRCULAR PLATES

THE equation for the nodal lines of a circular plate was worked out by Kirchhoff in 1850, having the form

$$w = J_n(kr) \cos (n\theta - \alpha) \qquad (1)$$

The first factor of this equation will give circles of different radii, while the second represents diameters. For nearly one hundred years this equation has been considered to be the most general possible solution so that the conclusion seemed inescapable that only circles and diameters could appear upon a circular plate. When plates are actually vibrated, however, many symmetrical patterns appear upon them which are certainly not circles. These variations from the theory were thought to be due to asymmetries in the plates, such as varying thickness, different tensions and so forth. If the assumption is made that a circular plate can give out two or more notes at the same time, then the equation of Kirchhoff may be extended in the form

$$w = AJ_n(kr) \cos n\ (\theta - \alpha_n) + BJ_m(k'r) \cos m(\theta - \alpha_m) \quad (2)$$

When this equation is zero (the condition for nodal lines), the resulting figures are much more complicated than mere circles and diameters. It will be proved that they correspond to the figures produced by experiment.

In Fig. 1 are shown tracings from photographs of circular vibrating plates. The originals will be found in another article by one of the writers.[1] Below them in Fig. 2 are the mathematical curves resulting from substitution in Equation 2 of the proper numerical values. The exact equations for these are in order:

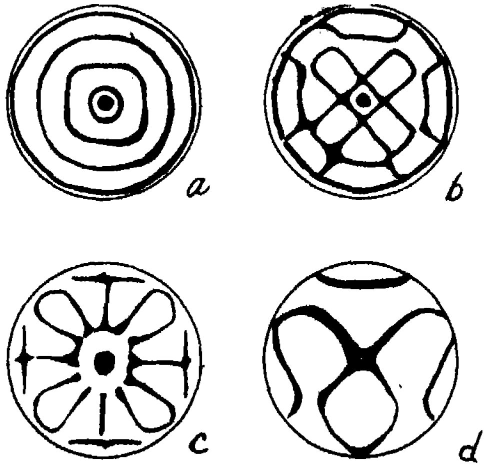

FIG. 1. Actual sand patterns obtained.

$$\left.\begin{array}{ll}
3J_0\left(\frac{12.53r}{a}\right) + J_4\left(\frac{11.95r}{a}\right) \cos 4\,\theta = 0 & (2a)\\
J_0\left(\frac{12.53r}{a}\right) + 2J_4\left(\frac{11.95r}{a}\right) \cos 4\,\theta = 0 & (2b)\\
J_2\left(\frac{5.937r}{a}\right) \sin 2\,\theta - 5J_6\left(\frac{11.00r}{a}\right) \sin(6\,\theta) = 0 & (2c)\\
J_2\left(\frac{5.937r}{a}\right) \cos 2\,\theta + J_3\left(\frac{3.497r}{a}\right) \cos 3\,\theta = 0 & (2d)
\end{array}\right\}(3)$$

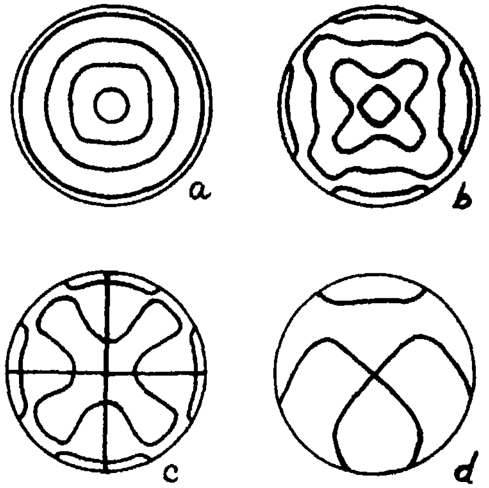

FIG. 2. Theoretical curves calculated.

The values of A and B are found by trial. After considerable experience one becomes more or less expert in picking out the number of circles and diameters in the Bessel and cosine functions which must be combined to produce any given figure. For instance, Fig. 2(c) is obtained as shown in Equation 3, for $A = 1$, $B = -5$. If these ratios are changed, another equation appears whose plot resembles 2(c) but differs from it in some important details. In Fig. 3 are shown two curves obtained from the equations

$$\left.\begin{array}{l}
J_2\left(\frac{5.937r}{a}\right) \sin\ 2\,\theta - 10J_6\left(\frac{11.00r}{a}\right) \sin 6\,\theta = 0\\
J_2\left(\frac{5.937r}{a}\right) \sin\ 2\,\theta - 10J_6\left(\frac{11.00r}{a}\right) \sin(6\,\theta - 5^\circ) = 0
\end{array}\right\}(4)$$

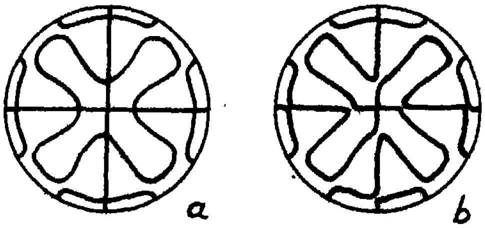

FIG. 3.

Simply varying the angle by 5° in Equation 4 causes the lines to split up. Both curves resemble that of Fig. 2(c) because similar functions are combined, although in different proportions.

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[1] Robert C. Colwell, *Jour. Franklin Inst.*, 213: 373–380, 1932.

Three functions may be added instead of two, or two functions may be multiplied together. The latter mathematical process indicates that two separate and distinct sets of lines may occur on a single plate at one time. Several such curves will be found in the last two pages of the article referred to above.

A fairly complete discussion of the method may be of interest whereby the mathematical curve of Fig. 2(*c*) is obtained from the Chladni plate shown in Fig. 1(*c*). To begin with it is usually best to take $A = B = 1$; by doing this one is often able to recognize related configurations which previously had escaped notice. In the Chladni plate Fig. 1(*c*), there are seen six diameters and at least one circle. This reduces the total possibilities to a limited number, and it is finally found by trial that the two modes of vibration which produce this Chladni pattern correspond to one circle and six diameters combined with one circle and two diameters. Now the correct values of the *k*'s for these circles are found in tables of Bessel functions. From these the equation

$$AJ_6\left(\frac{11.00r}{a}\right)\cos 6\theta + BJ_2\left(\frac{5.937r}{a}\right)\cos 2\theta = 0 \qquad (5)$$

is obtained.

When this equation is plotted the two predominant diameters are on the 45° and 135° lines. These can be related to the 0° and 90° lines by changing the cosine to sine. This changes Equation 5 to

$$AJ_6\left(\frac{11.00r}{a}\right)\sin 6\theta + BJ_2\left(\frac{5.937r}{a}\right)\sin 2\theta = 0 \qquad (6)$$

This is the first equation of the two shown in Equation 4, in which $A = 10$ and $B = -1$.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD FOR MEASURING AND RECORDING CONTINUOUSLY THE pH OF THE CIRCULATING BLOOD[1]

WITHIN recent years the glass electrode has been found readily adaptable to the continuous measurement and recording of the pH of the circulating blood in experimental animals. Of the more recent descriptions of a method of this type is that presented by Nims, Marshall and Burr.[2] Our report briefly describes a method similar in principle, but differing in details.

The units of the assembly employed consist of a chamber containing the glass electrode, a Cameron detector and pH meter, a potentiometer, a Leeds and Northrup mirror type galvanometer, a light source and a kymographic camera.

The essential features of the glass electrode assembly are shown in Fig. 1; during its use the ends of the severed blood vessel are attached to side inlet and outlet tubes, directly in case the vessel is large enough or by means of glass cannulae and rubber tubes. From the bottom of the chamber there is a recurved tubular extension to which there is attached a stiff rubber tube connecting with the KCl chamber containing the reference electrode. The electrode stem is held firmly in a tapered glass stopper which is ground to fit accurately the mouth of the chamber. The stopper is secured against arterial pressure by stopcock grease or rubber bands stretched between glass ears on both the stopper and chamber. The chamber with the electrode in place has a volume of approximately 1 cc.

For measuring the pH of the circulating blood the method of operation of the Cameron detector and meter is the same as that employed in the determination of the pH of any other fluid. The pH may be read directly from the dial; however, provision has been made for recording the electrode potentials by

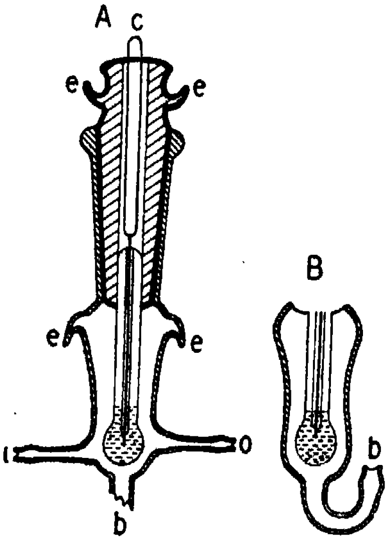

FIG. 1. A, cross section of the glass electrode and chamber, about two thirds natural size; b, position of salt bridge tube; c, wire contact; e–e, glass ears; i, inlet tube; o, outlet tube. B, cross section of the lower part of the chamber, showing the salt bridge tube more in detail. This tube lies in a plane at right angles to the planes of the inlet and outlet tubes.

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[1] This work was aided by a Fluid Research Fund from the Rockefeller Foundation.

[2] Nims, Marshall and Burr, SCIENCE, 87: 197, 1938.

inserting a double-pole-double-throw switch into the circuit of the galvanometer within the instrument. In one position of the switch the circuit within the meter is unaltered, in a second position the galvanometer in the meter is disconnected and an outside galvanometer is substituted without disturbing the adjustment of the meter.

A Leeds and Northrup galvanometer unit (2420-c) with a plane mirror and mounted on a heavy wood base is used for recording. A narrow beam of light reflected from the mirror moves across the slit of the camera placed at a distance of one meter. A potentiometer, inserted between the pH meter and the recording galvanometer, is used to control the excursion of the light beam for a given unit change in pH. The calibration on the record is obtained by moving the pH dial through a given interval, usually 0.1 pH, and photographing the resulting excursion of the light beam.

For rendering the blood incoagulable heparin has been used in some instances; but we have also found Pontamine Fast Pink BL or Chlorazol Fast Pink B, 200 to 250 mgm per kilogram, satisfactory.

This apparatus is quite rugged and stabile. Continuous records of the pH of the circulating blood can be made with an accuracy of at least 0.01 pH, and with good approximation to the third decimal place. The type of record obtainable is shown in Fig. 2. This record was obtained from a dog under barbital-sodium anesthesia. The animal, as indicated, was hyperventilated for one minute. Prior to the hyperventilation, as well as after that procedure, the breathing was of the periodic type. The record shows, in addition to the marked rise in the pH of the arterial blood incident to the hyperventilation, a definite fluctuation in pH with each group of respirations. In a number of instances, in animals breathing slowly and deeply, we have observed and recorded measurable fluctuations in the pH of the circulating arterial blood coincident with each respiratory movement.

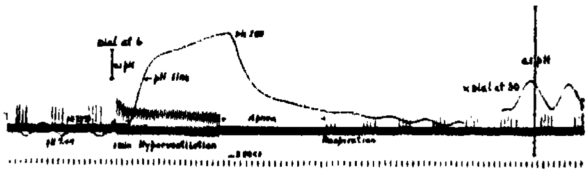

FIG. 2. A record of spontaneous breathing, hyperventilation, and the pH of the circulating arterial blood, obtained from a dog under barbital-sodium anesthesia. Dial readings refer to figures on the dial of the potentiometer between the meter and the recording galvanometer.

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A SIMPLE INEXPENSIVE DEVICE FOR ACCURATE DELIVERY OF SMALL AMOUNTS OF FLUID

To overcome the difficulties which are encountered when treating a large number of animals with small identical volumes of material, Dr. Robert T. Frank suggested that I devise an attachment for a tuberculin syringe which can be readily set and promptly made to deliver any desired amount of liquid. The device was not to interfere with quick assembly and cleaning.

The apparatus which has proved efficient consists of a spring clamp (A) encircling the barrel (C) with an arm (B) attached by a pivot. Both ends of this arm are bent at right angles. At the front end, facing the barrel, there is a sharp edge which engages the graduation lines etched into the barrel. The other end of the arm acts as a stop to the plunger (D) which carries a metal collar (E) with a flange to give a surface perpendicular to the stop. The amount delivered, when using this device, is as accurate as the graduation markings on the syringe. The device can be easily detached and applied to another syringe as required.

This device has been used with success by Dr. Robert T. Frank for injecting quantities as small as 0.02 cc.

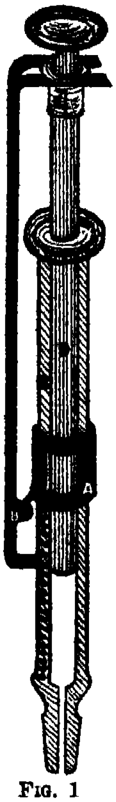

FIG. 1

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BOOKS RECEIVED

CHANDLER, ASA C. *Introduction to Parasitology; with Special Reference to the Parasites of Man.* Sixth edition. Pp. xiii + 698. 309 figures. Wiley. $5.00.

CONN, H. J. *Biological Stains; A Handbook on the Nature and Uses of the Dyes Employed in the Biological Laboratory.* Pp. 308. Biotech Publications, Geneva, New York. $3.40.

FRANKLIN, PHILIP. *A Treatise on Advanced Calculus.* Pp. xiv + 593. Wiley. $6.00.

HARROW, BENJAMIN. *Laboratory Manual of Biochemistry.* Pp. v + 119. 19 figures. Saunders. $1.50.

HEHRE, FREDERICK W. and GEORGE T. HARNESS. *Electric Circuits and Machinery. Vol. I, Direct Currents.* Pp. ix + 513. Illustrated. Wiley. $4.50.

MACDUFFEE, CYRUS C. *An Introduction to Abstract Algebra.* Pp. vii + 303. Wiley. $4.00.

POTTER, GEORGE E. *Essentials of Zoology.* Pp. 526. 204 figures. Mosby. $3.75.

TIMBIE, WILLIAM H. and VANNEVAR BUSH. *Principles of Electrical Engineering.* Third edition. Pp. ix + 549. 388 figures. Wiley. $4.50.

TRANSEAU, E. N., H. C. SAMPSON and L. H. TIFFANY. *Text-book of Botany.* Pp. xi + 812. 424 figures. Harper. $4.00.

WHITE, E. GRACE. *Principles of Genetics.* Pp. 352. 179 figures. Mosby. $2.50.

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THE NATIONAL ACADEMY OF SCIENCES[1]

ADDRESS OF WELCOME BY THE PRESIDENT OF THE UNIVERSITY OF PENNSYLVANIA

THE University of Pennsylvania has special gratification in extending a hearty welcome to the members of your distinguished body in the annual meeting which you are holding this week within our halls. You bring to our campus a group of scientists and educators who feel a certain definite obligation to the state in the several fields in which they are involved. Your association is one of creative possibilities. As your president pointed out in his remarks at the dinner of the academy a year ago your organization traces its origin into Colonial times, but there is a certain significance to the impetus which the movement gained through its incorporation under the approval of Abraham Lincoln at the time of our Civil War. And one reads with new inspiration these words from the first annual report of the academy submitted to Congress a year later:

> It is a remarkable fact in our annals that, just in the midst of difficulties which would have overwhelmed less resolute men, the 37th Congress of the United States, with an elevated policy worthy of the great nation which they represented, took occasion to bring the scientific men around them in council on scientific matters, by creating the National Academy of Sciences. Such has been the way in which the public mind has been stirred before in the annals of other countries, leading to the organization of great systems of education, science, art and literature, to be encouraged and perfected when more peaceful and prosperous times recurred.

This historic association augments the significance of the academy by the tradition of a great man, the mere mention of whose name makes us search our hearts with a view of doubling the earnestness of our efforts.

Now that the progress of civilization is imperiled by the unbridled and destructive forces of evil which have been unleashed abroad, you on your part stand prepared to furnish to your government all the resources which can be brought to bear through the academy, and through its instrumentality, the National Research Council, organized for the purpose among other things of strengthening the national defense and cooperating in the interest of the public welfare. And we on our part have offered to our government every man and every facility at our command for such purpose in the national emergency as our government may think helpful in the grave problems it has in hand. Our preparation involves also the organization of base hospitals, the setting up of Army, Navy and Pilot training corps, and our cooperation with plans having to do with registration and special researches and services bearing upon national defense. As before in our history when our services were useful or needed, we stand ready to make available to all departments of the Federal Government the special abilities, experiences and the capacities of each and every activity we possess.

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[1] Autumn meeting held at the University of Pennsylvania, Philadelphia, October 28, 29 and 30, 1940.

You come to the university in a year of great meaning to us. Founded by the many-sided Franklin two hundred years ago we find ourselves interwoven with the academy through a distinguished group of scholars deeply grounded in the objectives of each institution. Beginning with Bache, and coming through Frazier, Leidy, Lesley and two Rogers, Longstreth, Cope, Donaldson, Mitchell and Wood, we can trace adventures into the unknown through the dramatic lives of those who between us had common interests. By coming here in this special year you demonstrate again the vitality of democracy, the unity of purpose of intelligent men and the power of education, which in these times gives renewed faith and encouragement to us all. It is well that in some place there should be provided at just this time in the history of the world a platform from which the best minds in all fields of useful knowledge could give encouragement to a weary world. And while the location of such an event is not nearly so important as the circumstance it seems appropriate that the scene should be here in Philadelphia which saw the birth of American liberty, and is to-day more than ever a shrine from which free men may renew their inspiration. The bicentennial celebration of this university, which is being observed throughout the year, reached in a sense its high point during the present fall and the observances which have occurred emphasize again the fact that knowledge and learning know no boundaries of nationality, of creed, of race or social preference. We have all been inspired by the fact that great scientists and humanists invited to our commemoration came with enthusiasm and with generosity, and that those who could not come from overseas because of the war heroically stayed at home but sent to us for the benefit of learning and welfare their papers to be read by other colleagues in the free realm of scholarship.

From countries on both sides of the European and the Asiatic wars came messages of hope of a new tomorrow. From men of universities no longer in existence came letters and cablegrams pleading that the fires of freedom be kept burning as the hope of civilization. "Free science in America means free science for all the world," wrote the delegate from the University of Latvia, whose faculties have been banished.

Institutions such as those with which you and we are associated and the forces which lie back of them are older than any government in the world. Around them liberty and independence have grown. Education that is free and virile can exist only in a democracy. And democracy can exist only where education and intelligence grow guided by such institutions as yours and ours leading the people along pathways that are free and upward. Therein rests the hope of civilization for the kind of a future for which intelligent men and women are even now giving their genius, their energies and their lives.

One can not overstate the significance of a meeting such as this at the present time. Nor can one overestimate the lasting values which may result from our association together. There is inherent in the event the acceptance of the challenge to our collective abilities to meet and overcome the onslaught of a world ridden by fear.

THOMAS S. GATES

REMARKS AT THE DINNER BY THE PRESIDENT OF THE ACADEMY

THIS is neither the time nor occasion for any extended remarks on my part. Nevertheless I do wish to trespass on your good nature for a few minutes. I have learned something out of my experience these past eighteen months as President of the National Academy of Sciences which I would like to convey to you—members and guests alike.

To the members, particularly to those who have been members long, it is not particularly new, nor, as they may remember, is this my first reference to it. My justification for reverting to it now is that it is at present an important matter in connection with the functioning of the academy. To these older members I crave pardon in advance.

To you who are our guests, what I have to say is probably new. To all of you, members and guests alike, who are interested in or concerned with the *raison d'être* of the academy it is, I think, something you should understand clearly.

I suspect that most people outside its membership think of the National Academy of Sciences as some sort of a voluntarily created scientific society of limited membership, which differs from numerous other scientific and technical societies only in that its membership covers a wide range of scientific fields. They may or may not know that membership is attained not by application but by a rigorous and somewhat laborious process of election which involves judgment of a candidate's scholarly fitness. This judgment is not merely that of men in the candidate's own particular field but is equally the judgment of those in all the other fields comprised within the academy structure. Further, they may or may not know that final election is not by ballot of all the members of the academy but is by secret ballot of those members present at the annual meeting, taken after full discussion of the candidate's scientific achievements. So far as men are capable of doing it, this process seeks to select men judged to be eminent in some field of fundamental or applied science. Finally, the outsider may or may not know that the members of the academy gather together occasionally to present and discuss noteworthy new discoveries in science in a wide variety of fields, and once a year to replenish their limited membership.

In normal peaceful times, this is about all there is to the academy, so far as most of its members, as well as those outside its ranks, are concerned. Only the officers and the few members of standing committees or those concerned with the active work of its great agent, the National Research Council, are in such times kept continually alive as to what the academy really is. During these quiescent periods some, even of the members, tend quite naturally to consider the academy merely as something pleasant to belong to—a sort of exclusive scientific club, as it were, made up of men and women of distinction in science with a magnificent marble home in Washington.

Actually the academy is something quite different from this. It is *not* a self-perpetuating voluntary association but a self-perpetuating corporation chartered by Congress for a very definite and specific purpose. It is in fact a permanent quasi instrument of the Federal Government. By accepting election to membership in it men and women accept responsibility to serve the nation without remuneration whenever requested to do so by the government.

The Congressional Charter approved by President Lincoln, March 3, 1863, is an astounding state paper which pays tribute to the statesmanship not only of Mr. Lincoln but of A. D. Bache, the academy's first president, Louis Agassiz, Asa Gray, Joseph Henry, Benjamin Silliman and the numerous other distinguished scientists of the time. These men, who were the original members of the academy, were not a voluntary association of men having a common interest in science. They were designated by Congress as the original members of a permanent corporation created by the supreme authority of the nation. The fact that among these original designated members were a considerable number of distinguished Army and Navy officers is evidence of a primary purpose which Congress and the President had in mind.

The entire Act of Incorporation consists of but three sections and covers less than a single small printed page. The first section, which comprises nearly two thirds of the document, is a mere recital of the names and states of residence of the incorporating members—ten of whom were from Pennsylvania. The second section, of seven lines, gives the corporation what is essentially a white card as to all things pertaining to its operation, including its rules and the election of members. It also provides for reports to Congress.

In the original charter Section 2 also limited the number of members to 50. By further Act of Congress in 1870, all limitation of numbers was removed and membership was left to the sole discretion of the corporation.

The last section, of less than a hundred words, provides that the academy shall hold an annual meeting at some place of its own choosing within the United States. It also imposes the obligation that ". . . the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment and report upon any subject of science or art . . ." the actual expenses to be paid by government but the academy to receive ". . . no compensation whatever for any services to the Government of the United States."

This Section 3, which is always incorporated in any contracts or formal understandings of the academy with government departments, is the price exacted of the academy for the complete freedom accorded it in Section 2. It is also the proviso which indirectly over the past seventy-five years has determined the qualification of men for membership and the whole machinery of nomination and election.

By this simple expedient of giving the academy essentially unlimited freedom to administer its own affairs and in return exacting merely an obligation to serve the nation when requested, the charter in effect ordained that the membership should always consist of men and women of established scientific competence, since otherwise the academy could not carry out its charter obligation.

In normal times the requests of government on the academy are not numerous and usually not of an urgent character. They never deal with unimportant matters, however.

In times of stress, like the present, things are quite the reverse. Requests for advice then become numerous and more frequently than not, urgent.

Beginning about two years ago, requests began to peak up in accelerated fashion and during the past eighteen months the academy, either directly or through its agent, the National Research Council, has been called upon to advise, study and report on a wide variety of matters, in which the actual costs paid by government under the charter are running at the rate of a number of hundred thousand dollars a year. When it is remembered that the services of the academy and its members, and the services of all those it appoints on its committees, are furnished without remuneration, the full scope of the aid rendered by the academy under its charter obligations can be appreciated.

These requests for study and advice have come from the President, from numerous branches of the Army and Navy, and from many of the civil departments, boards and commissions, both permanent and temporary. The problems these requests present are vastly more varied than are their origins. Recently numerous requests for assistance involving much work have come from temporary defense organizations, and more are in prospect. Many of them are matters of great urgency involved in decisions of public policy and the expenditure of large sums of public money.

The permanent organization of the academy and council, built up over the years, is of inestimable value in selecting quickly the most qualified men in any field of science for the particular study required.

While the load of work imposed on the officers of the academy and council and on many of the members in handling these requests has disabused our minds of any lurking thought we may have harbored that membership was an ornamental sinecure, it has been an interesting experience. So far as I personally am concerned, it has given me added respect for those men who, in the midst of a devastating civil war, could create in such a simple structure an organization so lasting, so powerful and so flexible to changing conditions as the one they adopted. It is difficult for me to conceive of a more effective structure for insuring that at all times government be in position to avail itself of the most competent unbiased assistance science can provide. Temporary organizations have been in the past, are now and will continue to be created in times of emergency to supplement the work of the academy and council. They are, however, more likely than not to pass off the stage with the passage of the emergency which brought about their creation.

As indicated above, the simple expedient adopted by Congress in the academy's charter forged the strongest possible chains of service. Because it appeals merely to the honor of men, nothing can be more compelling than an obligation to serve, coupled with a guarantee of complete freedom to render that service in the best way they can themselves devise. The strength of the academy and its ability to discharge its obligations lies solely in the character and eminence of its members and of those it selects to aid it. It does not reside in numbers, since there is no limitation to those it may ask to aid on occasion, nor does it reside in any statutory authority to enforce its findings or opinions. Fortunately, the academy has no such power and so no temptation to become dictatorial.

The most powerful force within the academy and about the only one which acts on all of the members is therefore the one concerned with the quality of men. The fact that the load of work is unequally distributed among the membership, and that many of the members may never be called upon to render personal service, matters little. The character of the problems presented determines where the burden will fall. What is important, and what makes it possible for the academy directly and indirectly to render service, is that it should be composed of men and women who have established their competence as real contributors to an enlarging science.

If further proof be needed of the power of the simple setup of seventy-seven years ago, it is to be found in the fact that not once in the many scores of calls for personal time-consuming unremunerated assistance that the academy has made on men during the past year has there been a single declination. While many of the calls have been to members of the academy or National Research Council, the great majority have been to men outside either. Nor has there been, so far as I am aware, a single instance in which the advice given government has not been followed or has been questioned.

So long as the eminence of its membership is maintained, the Congressional Charter provides an almost impregnable citadel for disinterested service to the nation. It is a shield against the pressures of expediency, influence and the thousand and one things which so frequently bedevil and thwart our group undertakings.

I have a feeling that the pattern of permanent formal relationship between government and self-operating groups of its citizens, exemplified by the academy charter, could be copied to great advantage in numerous other fields.

To give you some idea of the scope and variety of the problems which have been submitted to the academy during the past year, the following partial list may be of interest. Some of them have been handled by committees of the academy alone and more by committees jointly appointed by the academy and council. Due to the magnitude and increasing complexity of the problems we are more and more employing the joint committee scheme.

1. From the President of the United States—Study and report on a method of instrument (blind) landing for aeroplanes to be standardized and employed at major flying fields.

2. From the Civil Aeronautics Authority—Comprehensive study of the whole method of selection and training of pilots. This is a very considerable task which is extending over two years, and which involves work at many institutions of learning.

3. From the National Resources Planning Board—Study and report on industrial research in the United States.

4. From the Advisory Commission to the Council of National Defense—(a) Study and report on the whole problem of utilizing domestic low-grade manganese ores; and (b) Study and report on the erection of a tin smelter to refine low-grade tin ores from Bolivia.

5. From the Army and Navy—Numerous problems concerned with National Defense. Some of these are handled by permanent committees of the academy and some by special joint committees. Many of them involve much and long-continued work and the expenditure of large sums of money.

These are but samples picked at random from a long list.

Frank B. Jewett

ABSTRACTS OF PAPERS

A white-flowered race of Datura from aged seed which is genetically distinct from similar white races in nature: Albert F. Blakeslee and A. G. Avery. In *Datura stramonium* there are two color forms, one with white flowers and green stems, the other with purple flowers and stems. In the current manuals they are recognized as distinct species, *D. stramonium* and *D. tatula*, but differ only in a single pair of genes located in the ·18 half of the 17·18 chromosome. From seeds aged 7½ years, a recessive white-flowered type segregated out in the F_2 generation which was indistinguishable in appearance from the wild whites. When crossed with a standard white from nature, the F_1 plants were purple, a fact which showed we were dealing with a new gene for white. By appropriate tests this new gene has been located in the ·16 half of the 15·16 chromosome. The possibility that more than one recessive gene might be responsible for the different wild whites was tested by crossing standard white testers with over 400 white races from nature. If any of these whites had been determined by a different gene from that responsible for the white flowers of the tester, their F_1's would have been purple. The F_1's, however, were all white, a fact which proves that there was only one gene for white flowers in the 400 races. Since these races were secured from widely separate parts of the world, including all the continents, and represented all the recurrent chromosomal types found in nature, it is probable that no new gene for white flowers in this species has become established in the wild. In *D. ferox*, a gene for white flowers which is located in the ·4 half of the 3·4 chromosome causes the corolla and stamens to be white and the stem and leaves above the cotyledons to be green. In flower color the herbaceous Daturas are limited to two types—purple and white.

Physiological differentiation of Astragalus in response to selenium: Sam F. Trelease (introduced by W. J. Robbins). The growth of *Astragalus racemosus* and *A. pattersonii* in solution and sand cultures was greatly increased by the element selenium (as selenite or selenate) in concentrations up to 27 ppm., and the plants accumulated large quantities of selenium. Selenium seems to be an essential mineral element for these species of *Astragalus*. In marked contrast, *A. crassicarpus* was not stimulated by selenium in the culture solution but was instead poisoned, being severely injured by 0.33 ppm. and killed by 9 ppm. This species is able to absorb only small quantities of selenium, and its physiological response is like that of wheat, buckwheat, soy beans or tobacco. *A. racemosus* and *A. pattersonii* are indicators of seleniferous areas. But *A. crassicarpus*, since it is neither benefited by selenium nor poisoned by the very low concentrations existing in natural soils, does not serve as an indicator. Field studies in collaboration with Professor O. A. Beath have shown thus far that twenty-three other species are like *A. racemosus* and *A. pattersonii* in being selenium indicators, whereas many other species of *Astragalus* resemble *A. crassicarpus* in being indifferent to selenium in natural soils. The indicator species fall into six of the twenty-nine groups into which M. E. Jones divided the genus *Astragalus* on the basis of morphological characters. All members so far examined in the groups Bisulcati, Ocreati, Podo-sclerocarpi and Preussii are selenium indicators; and no member studied in the groups Uliginosi, Flexuosi, Inflati, Homalobi, Angophylli and Hypoglottides is a selenium indicator. The groups Galegiformes and Lonchocarpi seem to require revision, since each includes both indicator and non-indicator species. Physiological differentiation of *Astragalus* with reference to selenium provides a new approach to the division of this difficult genus into groups representing relationships and evolutionary development.

Sensitivity of gladiolus corms during an artificially prolonged rest period: Frank E. Denny (introduced by B. O. Dodge). Although gladiolus corms when freshly harvested are dormant, they pass through this rest period, usually in one to three months, and then will germinate promptly when planted. This rest period may be prolonged for many months or for two years or more with certain varieties by the simple expedient of replanting the *freshly harvested* corms in *moist soil* and *storing at room temperature* or preferably at about 27° C. With the passage of time, corms with a rest period artificially prolonged in this way become sensitive to low temperatures, such as 0° and 5° C. Germination can then be induced by short periods of chilling such as 48, 24, 12 or even 6 hours, depending on the variety and the duration of the period of enforced rest at the time of the exposure to cold. During this long rest period the corms show an exceptional type of respiration. When first removed from the soil after a sojourn in it of several or even a few months, the carbon dioxide production at the temperature which prevailed during the storage in soil is very low, approximately 2 to 10 mg CO_2 per kg per hour. This low rate is maintained, however, for only 4 to 8 hours, when the rate rises rapidly until within 24 to 48 hours it reaches 20, 40, 80 or even more than 100 mg. From this maximum the respiration curve falls gradually until after 5 to 7 days the original low rate is reached, this being maintained indefinitely. In spite of this great change in respiratory activity the rest period is not broken, but these corms retain their dormancy, may be again planted in soil and become available for another respiration test. The curve is again given by a subsequent test, provided the period in the soil following the first removal is approximately three months. During the first few hours after removal from the soil (when the rate is low and rising) the volume of oxygen taken in is much larger than the volume of carbon dioxide given off, approximately two to three times as large; but at the time of the maximum rate, and in the entire period during the falling rate, even to the time of the secondary minimum, the volumes of O_2 and CO_2 are equal.

Growth of excised roots and heterosis in tomato: William J. Robbins. Excised roots of two inbred lines of tomato and the heterotic F_1 were grown under sterile conditions in liquid media. The seeds from which the excised roots came were furnished through the courtesy of C. B. Lyon. The roots were grown in a mineral salt-sugar solution supplemented with thiamin, with thiamin and vitamin B_6 or with thiamin, vitamin B_6 and nicotinic amide. Under the experimental conditions used the roots of the hybrid grew more in all three types of solutions than those of either parent. The roots of one parent showed a greater response to vitamin B_6 than to nicotinic amide, the roots of the other parent showed more response to nicotinic amide than to vitamin B_6. The roots of each line showed a characteristic morphology. It would appear that hybrid vigor is not limited to the top of the plant and that a study of the growth of excised roots of inbred parents and their heterotic offspring may throw light on the physiological basis for hybrid vigor.

Theoretical and experimental studies on protoplasmic streaming: William Seifriz and Noburo Kamiya (introduced by A. N. Richards). Protoplasm is often in active motion. In certain lowly plant forms, this motion, known as protoplasmic streaming, occurs in one direction only at a time. Reversal in direction of flow takes place rhythmically. The phenomenon is best illustrated in the slime molds. Hypotheses on the mechanism of protoplasmic streaming have been numerous. Surface tension, hydration, electroendosmosis and contractility are some of the forces which have been held responsible. The technique known as "time lapse" in cinematography has revealed a rhythmic pulsation of the plasmodium or body of a slime mold. The senior author regards this rhythmic contractility as the mechanism responsible for protoplasmic flow. The contraction and expansion of the plasmodium is perfectly synchronized with the outward and inward flow of the protoplasm. The theory is extended to include all forms of protoplasm. Rhythmic movements of tissues exist in virtue of the innate attribute of contractility in the protoplasm of which they are made. The chemical or physical basis of protoplasmic contractility is probably to be found in the contraction of folded protein molecular chains. The next step in our studies was the measuring of the motive force responsible for protoplasmic flow. The junior author set about to accomplish this. Through the development of a suitable technique it has been possible to oppose the force which moves protoplasm. A single strand is selected and so placed in a divided chamber that one half may be subjected to pressure while the other half is left unopposed. If, by this means, the protoplasm, where observed, is held still, the counter-pressure applied is a measure of the motive force responsible for streaming. The counter-pressure which is just sufficient to keep protoplasm quiet changes rhythmically. The range of this pressure, and therefore of the vital protoplasmic force, is between ± 25 cm of water. Instantaneous values of the balance pressure, taken every five seconds, and plotted against time, yield undulating curves which reveal such characteristics as frequency, amplitude and irregularities of the rhythm in protoplasmic activity. One of the most extraordinary of these is the presence of more than one rhythm: in short, protoplasm is a polyrhythmic system.

Formation of crystalline cellulose in plastids of living cells: Wanda K. Farr (introduced by C. B. Davenport). In 1934, uniform-sized, cellulose crystallites ($1.1\,\mu \times 1.5\,\mu$) were identified in cell membranes from various parts of the plant kingdom by means of microscopic, chemical and x-ray diffraction analyses. During the period of cell membrane formation these cellulose particles appear in the outer regions of the cytoplasm of a living cell, such as the cotton fiber, arranged end to end in orderly, single rows. The particles are coated with a viscous substance which holds them together to form the fibril and the fibrils, layer upon layer, to form the cell membrane. In the course of these earlier observations of the formation of plant cell membranes by cellulose particles and cementing substance elaborated in the protoplasm of living cells, no clue was obtained as to the mechanism of formation of the particles. The tropical marine alga, *Halicystis ovalis*, proved to be excellent material for the solution of this problem. Upon the inner surfaces of the membranes of its chloroplasts are formed, successively, rings of varying diameter and equal thickness. These rings fragment directly to produce the uniform-sized cellulose particles. In many types of cells of higher plants colorless plastids produce cellulose particles by essentially the same mechanism. In chlorophyll-containing cells of the higher plants, starch is formed in the chloroplasts and cellulose in separate plastids containing no pigment. Starch formation was observed in plastids of living cells before 1850. Cellulose formation has been more elusive and the mechanism which we now find in operation has been hitherto undescribed.

Observations on parasites and inclusion bodies in certain intestinal protozoa: David H. Wenrich (introduced by C. E. McClung). Bacterial and fungoid parasites of Protozoa have been known for more than half a century. They were earlier seen in various kinds of free-living species, but during the past thirty years an increasing attention has been given to such parasites associated with endozoic Protozoa. Some of these associated organisms are ectozoic and others are endozoic. Some may be symbiotic; for example, in the flagellate, *Lophomonas striata*, from the intestine of cockroaches, rods of the genus *Fusiformis* seem always to be present, persisting through division and encystment. Members of the genus, *Sphaerita*, considered to belong to the fungoid group, Chytridiales, are intracytoplasmic parasites, while members of the related genus, *Nucleophaga*, are intranuclear. Kirby (*Proc. Third Internat. Cong. for Microbiology*, 1940) has recently called attention to an extensive list of both ectozoic and endozoic forms associated with the Protozoa in termites. The present report is confined to associates of certain of the intestinal flagellates and amoebae of man and some other vertebrates. I have previously reported short oval rods adhering to the surface of *Trichomonas hominis* and of Diplococcus-like forms adhering to *T. vaginalis*. Short rods have recently been found on the surface of *T. augusta* and *T. batrachorum* in frogs and toads. In amphibian hosts, also, long slender rods are frequently found on the surface of *Monocercomonas* (*Eutrichomastix*) sp. and apparently the same kind on the surface of *Retortamonas dobelli* from the same hosts. Intracytoplasmic rods of various types have been found in trophic stages of *Chilomastix bettencourti* and trophic and cystic stages of *Giardia simoni* of rats and mice, and in *Trichomonas augusta* and *Chilomastix caulleryi* of amphibia. I have found species of *Sphaerita* in the flagellates, *Trichomonas muris, T. parva, T. minuta* and *Chilomastix bettencourti* (trophic and cyst stages), from rats and mice; in *Trichomonas augusta, T. batrachorum, Retortamonas dobelli, Hexamastix* sp. and *Monocercomonas* sp. from frogs and toads. I have also found members of this group in the parasitic amoebae, *Entamoeba coli* (trophic), *E. histolytica* (trophic and cyst), *Endolimax nana* (trophic and cyst), *Iodamoeba bütschlii* (trophic). There is evidence that there may be two species of *Sphaerita* in *T. muris*. There is also evidence that a flagellate may rid itself of parasites by detaching a blob of cytoplasm containing them from the posterior end. Evidence indicates that *T. augusta* also rids itself of parasites in the same manner. I have found intranuclear parasites, possibly belonging to the genus *Nucleophaga*, in *Trichomonas muris* and in the following amoebae: *Endolimax nana* (trophic and cyst), *Iodamoeba bütschlii* (cyst), *Entamoeba histolytica* (cyst), *E. muris* (trophic and cyst) and *E. ranarum* (trophic). Rather homogeneous inclusions have been seen in the cytoplasm of *Trichomonas muris, T. augusta* and *Chilomastix bettencourti* trophic stage. While these may be some special type of food or some unrecognized parasite, they are also similar to the intracellular inclusions of metazoa associated with filterable viruses.

Mating and metabolism in Paramecium calkinsi: EDGAR J. BOELL and LORANDE L. WOODRUFF. The respiration of two mating types of *Paramecium calkinsi* has been measured by means of the Cartesian diver technique in order to establish the normal rate of oxygen consumption for this species, and, in addition, to determine whether a physiological basis for the difference in mating behavior between the types can be discovered. The mating reaction in this species is represented generally by the formation of a clump ("agglutination") of large numbers of individuals of both types from which pairs of Type I and Type II animals then emerge. In animals in which the mating reaction consists of clumping with subsequent pairing, the average rate of oxygen consumption per animal per hour is 0.25 mμl for Type I and 0.28 mμl for Type II. This difference possibly is due only in part to a real metabolic difference between the types, since the average size of Type II animals is slightly greater than that of Type I. When the physiological state of the Paramecia is such that neither clumping nor pairing will occur, the oxygen consumption is much larger than when both of these phases of the mating reaction are manifest. The average respiratory rates for Type I and Type II animals are then, respectively, 0.43 and 0.48 mμl per animal per hour. Occasionally, the mating reaction consists only of the clumping phase—the mass of individuals then breaking up without the formation of pairs. In such cases, where clumping but no pairing occurs, the individuals of one type show the low rate of oxygen consumption characteristic of Paramecia which will both clump and pair, whereas the individuals of the other type respire at the typically high rate of animals in which mating tendency is absent. The results indicate that an inverse relationship exists between metabolic level and mating tendency and that clumping without pairing will occur between animals in which one type possesses a low rate of metabolism, while that of the other is high. Further evidence that clumping requires that a low metabolic level (and hence a positive mating tendency) exist in only one of the mating types is seen in the fact that clumping between living Paramecia of one type and a dead animal of the other sometimes occurs.

The composition of snake populations: EMMETT R. DUNN (introduced by D. H. Tennent). (1) Snake populations are made up of a few common species and a larger number of rare species. In general the commoner tenth of the species make up half the population; the rarer half of the species make up a tenth of the population. This relationship was first worked out for four areas in Panama, with snake faunas of many species, represented by some ten thousand individuals collected at random. It has been found to hold good as far north as California and Pennsylvania, and on faunas of as few as seven species. (2) The Panama areas each have a quite similar list of species, but a quite different list of dominant species. (3) The abundance of individuals in nature, as shown by the Panamanian statistics is not correlated with wideness of range of the species, number of species in the genus or number of genera in the family.

The primitive streak in embryos of the Macaque monkey: GEORGE L. STREETER. In embryos of the Macaque monkey, and probably of man and most mammals, the primitive streak is found to be in direct line from the primordial germ-plasm of the one-cell stage. In accepting the principle that development consists in proceeding from the more general to more specialized cells, the primitive streak is to be designated as the locus of the second order of such specialization, the first being when the auxiliary elements of the egg separate themselves from the true formative elements. The primitive streak in a strict sense is not ectoderm any more than was the original one-cell egg. From it, however, the primary embryonic tissues known as ectoderm, mesoderm and endoderm are derived. This step constitutes a second order in specialization, and the derived cells are therewith limited in their potentialities to their particular types of development. That is to say, the primitive streak is not a defined embryonic tissue but constitutes what remains of the primordial mother cytoplasm, changed only in being drained of the specialized cells that are moving out and away from it to fulfil their various limited careers.

A single series vs. many pairs of sex factors in the wasp Habrobracon: P. W. Whiting (introduced by C. E. McClung). Snell (*Proc. Nat. Acad. Sci.*, 21: 446–453) postulated that sex differences might be determined by many pairs of independently segregating Mendelian factors. If the members of any one or more of the pairs were different, the wasp would be female: otherwise it would be male. It has now been shown that these factors do not occur in separate pairs, but in a single series (alleles). This has been done by tagging them with the gene causing fusion of antennal segments. The gene fused has been introduced into two stocks having different sex factors. In each stock the sex factors proved to be similarly linked with this gene. Therefore these sex factors must be in a single series.

Artificial mixing of incompatible germ-plasms in Drosophila: Hermann J. Muller. It has often been asserted that the differences between "good species" of animals, such as those which give sterile "mules" when crossed, are probably not Mendelian or chromosomal, and that the findings of geneticists therefore do not concern the more fundamental features of living things. As genetic analysis of such differences would require the obtaining of mixtures of various kinds—"recombinants"—that would only arise in the later generations of crosses between the two contrasted types, the impossibility of breeding the first generation hybrids has hitherto hindered a direct attack on the above problem. *Drosophila melanogaster* and *D. simulans* are examples of two such "good species," which in nature yield only sterile hybrids. We have found it possible to circumvent the difficulty inherent in this sterility, and to obtain and distinguish, in the first generation of this species cross, the types that would be characteristic of the second generation, derived from a back-cross between the sterile hybrids and pure *melanogaster*. The method involves the crossing of triploid *melanogaster* females, which produce eggs with some extra chromosomes, by x-rayed *simulans* males, which produce sperms with some incapacitated chromosomes. This situation provides opportunity for some of the offspring to receive two chromosomes of a given kind from one species and none of that kind from the other species, while at the same time, in the case of other kinds of chromosomes, they receive one chromosome from each species. Study of the different types thus produced gives evidence that those differences between these species which cause their hybrids to be sterile morphologically abnormal or inviable are dependent upon the properties of their chromosomes. The abnormalities can be analyzed into a series of effects, each of which results (as in Dobzhansky's crosses between different "races" of *Drosophila pseudoobscura*) from the inharmonious interaction of a factor or factors in a given chromosome derived from one species with another ("complementary") factor or factors in chromosomes from the other species. A "recombinant" female having all its major chromosomes from *melanogaster* and only minor chromosomes (the Y and one fourth) from *simulans* was normal and fertile—the only fertile hybrid—a result that verified the whole interpretation. By breeding this female the minor chromosomes were established in stocks which otherwise were purely *melanogaster*. It was found that in this *melanogaster* setting various genes of these minor chromosomes fail to act in precisely a normal manner. This supports our inference that the number of cryptic genetic differences between species far outrun those causing obvious differences between them or those working in a "complementary" way to cause abnormalities of their first-generation hybrids.

Cancer in catfish; pathology and transmission: Balduin Lucké and Hans Schlumberger (introduced by Peyton Rous). Experimental cancer research has hitherto been done mainly with warm-blooded animals, because it has generally been thought that among the more primitive cold-blooded vertebrates, neoplasms are rare and consequently not readily available for investigation. However, a systematic search has revealed that various kinds of neoplasms, similar in structure and behavior to those in mammals and birds, are actually common among the lower vertebrates. Of such tumors one of the most suitable for studying certain phases of cancer is an epithelioma which frequently affects the catfish (*Ameiurus nebulosus*). During the past year the number of tumor-bearing fish obtained from streams in New Jersey and Pennsylvania has exceeded one hundred. This cancer usually occurs as a large, red, fleshy mass on the lips or the dental plates; less often it involves other parts of the mouth and rarely it extends to the skin. Sometimes the tumor becomes so massive as to prevent closure of the mouth. In approximately one third of the cases, a secondary tumor develops on that part of the opposite lip in direct contact with the primary growth. Histologically, the neoplasms consist of masses of epithelial cells which at first grow in an outward direction and show little tendency to invasion. But as the tumors become larger, they extend into adjacent tissues, and not infrequently they are seen to have pushed into vessels, where they form emboli. Experimentally, we have transmitted the neoplasm to fish of the same species by implanting it in the cornea of the eye, where it readily becomes established. The rate and mode of growth of the transplanted tumors have been followed over periods of several months by periodic examination of the living tumors. This was done by throwing a beam of light onto the tumor, which was then observed through the transparent cornea with the microscope. It was thus learned that this cancer always develops according to a definite structural pattern, namely, in the form of undifferentiated membranes which gradually thicken and become more compact. In this manner growth continues until the tumor fills the cornea.

Cyclic changes in the mammary gland of the monkey: CARL G. HARTMAN and HAROLD SPEERT. A large and controversial literature has arisen concerning changes in the human breast in relation to the menstrual cycle. Since the phenomena accompanying the cycle in man and monkey parallel each other in so many respects; and since the monkey breast is so well adapted for study and is readily obtainable the matter was investigated in a series of nine regularly menstruating monkeys. It was found that there is a definite cycle when ovulation has occurred, none in the absence of ovulation. The chief changes consist of enlargement of the lobules and dilatation of the ducts. These changes begin to be manifest several days after ovulation and occur in accelerated tempo until they reach their maximum in the late premenstruum. The relation of these findings to the physiological action of estrogens and progesterone will be discussed.

The piezo-electricity of beta-quartz: A. W. LAWSON (introduced by D. W. Bronk). In distinction to the generally accepted belief that beta-quartz is not piezo-electric, the existence of piezo-electricity in quartz above 575° C., originally observed by Osterberg and Cookson, has been confirmed. Piezo-electricity was observed in small crystalline fragments of quartz up to about 800° C. by the "click" method. A suitably cut quartz bar was excited to longitudinal vibration which could be detected by both the click method and measurement of the impedance of the quartz with a peak voltmeter up to about 650° C. The observations suggest that the disappearance of piezo-electricity in beta-quartz at higher temperatures attributed by Osterberg and Cookson to the appearance of a new phase is due to the rapidly increasing electrical conductivity of the quartz.

Relative acid strengths in various solvents: MARTIN KILPATRICK (introduced by A. N. Richards). It has been shown experimentally that the ratio of the dissociation constants of the substituted benzoic acids to that of benzoic acid yields a sequence of relative acid strengths which differs from solvent to solvent. In general the meta and para substituted acids become relatively stronger in solvents of low dielectric constant while the reverse is true for ortho substituted acids. The effect of the meta and para substituents can be interpreted in terms of electrostatic effects, but the observed effect with decreasing dielectric constant is greater than the theoretical.

(To be continued)

OBITUARY

HENRY McELDERRY KNOWER

HENRY McELDERRY KNOWER, son of Captain Edward C. Knower, U. S. A., and Mary D. (McElderry) Knower, was born in Baltimore, Maryland, on August 5, 1868. His death, at the age of 71, occurred in his native city on January 10, 1940. He was educated at schools in Baltimore and at the Johns Hopkins University, where he received the A.B. degree in 1890. Continuing there as a graduate student under the late Professor William K. Brooks, he was awarded the doctorate of philosophy in 1896. During this period he served as assistant for two years and the last year he held the Adam T. Bruce fellowship.

After obtaining his Ph.D. degree Knower was appointed to an instructorship in biology at Williams College but returned to Baltimore the following year and in 1899 became instructor in anatomy in the Johns Hopkins Medical School, where he remained ten years, the last year as associate. From Baltimore he was called in 1909 to the University of Toronto as lecturer in anatomy, and in 1910 he became professor and head of the department of anatomy at the University of Cincinnati. After his resignation from this post in 1924 he served as visiting professor at the University of Georgia (1925–27) and then as professor of anatomy at the University of Alabama until 1929. From 1930 to 1932 he was associate professor of anatomy in the Albany Medical College of Union University. His last appointment was that of research associate in biology at Yale University (1933–37).

In the late nineties Knower attended a number of sessions at the Marine Biological Laboratory, Woods Hole, and in 1908 became a regular summer resident. He served there as librarian from 1909 till 1919, during which period the library grew rapidly and was well arranged and catalogued.

In 1897 he married Miss Virginia Du Barry, who survives him. They had two children, Henry Du Barry, whose death late in 1939 was a severe blow to his father at a time when he himself was critically ill, and Virginia (Mrs. William A. Moore, of Bronxville, N. Y.). There are five grandchildren.

Knower's first research work dealt with the embryology of termites, in which he became interested on an expedition to Jamaica in 1891. This was the subject of his doctoral dissertation, which was published in Volume 16 of the *Journal of Morphology.* After his appointment in anatomy his interests naturally shifted to problems more closely related to that field. He became absorbed in the study of the development of the vascular system, first through the demonstration of the lymph hearts and vessels in embryos from which the systemic heart rudiment had been removed. In Dr. Mall's department during this period there was much interest in the vascular system. Knower made essential improvements in the technique of micro-injection by blowing a bulb at the end of the capillary injector and using gentle heat, applied to the bulb, to propel the injection fluid. Through the years which followed he made extensive studies of the development of the vascular system, both blood vessels and lymphatics, and accumulated a vast collection of injected material, including embryos of various species of urodele and anuran amphibians and of fishes. Brief reports on this work were made from time to time at the meetings of the American Association of Anatomists, where his specimens were demonstrated, but it is only upon the anuran material that a full report was published, as one of the *American Anatomical Memoirs.* This was finished and put through press less than a year before his death, at a time when his physical condition was such that it seemed scarcely possible for him to work at all.

These investigations led to the conclusion that the lymphatics spread first from a center connected with the anterior lymph hearts, which pump the lymph into a tributary of the pronephric sinus. The process of growth is by budding, and in this Knower agrees with Hoyer, Sabin and Clark and is opposed to the lacunar theory. He did not reach this conclusion without careful consideration of the evidence, and, indeed, open-mindedness and critical judgment characterized all his work.

Knower will, perhaps, be remembered as much for his services in the establishment of the *American Journal of Anatomy* and the *Anatomical Record* as for his special investigations. At the close of the last century journals for the publication of anatomical and zoological research were altogether inadequate; in fact, aside from certain institutional publications, they were almost non-existent. On account of financial difficulties the *Journal of Morphology* had just been discontinued (fortunately only temporarily) and there was nothing to take its place. This was about the time when the Association of Anatomists was undergoing reorganization at the hands of a younger group of men who were active in anatomical research as understood in continental Europe. The need of a new journal was generally felt, but there was hesitancy about setting up any more institutional publications. Cooperative action was needed. Knower often discussed this situation with Mall, and late in 1900 determined to go ahead with the organization of the *Journal of Anatomy.* He visited various laboratories, secured pledges of financial support, and won the cooperation of the distinguished group of men that afterward formed the editorial board of the journal, which was nearly identical with the group that had been active in the reorganization of the association. When the editorial board was founded, Knower became its secretary, virtually managing editor, which position he held until 1921, when the ownership of the journal was transferred to the Wistar Institute. In those days the managing editor of a scientific journal was a combination of editor, business manager and office boy, and a lot of hard work was required to make the enterprise successful. Knower served with great devotion and tact, and this, together with the unselfish cooperation of the board, insured the success of the journal from the start. It is odd that he was never given the title of managing editor. Whatever may have been the reason, it was not lack of appreciation of his services. There are in his files many letters from members of the editorial board and from those who contributed funds for the journal, including President Daniel C. Gilman, that are most complimentary and appreciative. One of these, the last one written him by Dr. Charles Sedgwick Minot and dated June 26, 1914, announcing a grant from the Elizabeth Thompson Fund for Knower's research, may be quoted:

> We have from experience learned to look upon grants for illustrations as rarely desirable. In your case I explained to the Board that your University was probably not able to assist you much in that way but the deciding consideration was that you had done a great deal of devoted work for the Journal of Anatomy of the sort that necessarily receives little attention and excites none too much gratitude. The Board hopes that you will consider the grant partly as an expression of appreciation of your very real service in promoting the cause of Anatomy in America. It is a personal pleasure to me to write this to you.

The *Journal of Anatomy* naturally became the official organ of the Association of Anatomists, and some years later the need was felt for another type of publication that would bring out shorter articles, book reviews and news items of interest to anatomists, including the proceedings of the association. Thus was established in 1906, at Knower's initiation, the *Anatomical Record,* which was printed for the first two years as a supplement to the journal. During this period Knower, as editor, contributed frequently to its pages, but by 1908 it had made such a place for itself that it was established as an independent journal with its own editorial board.

As teacher and director of an anatomical institute Knower's main sphere of activity was at the University of Cincinnati. When he was called there in 1910, only a year after the publication of Flexner's report on medical education in the United States, two of the proprietary medical schools in Cincinnati had been united and had become affiliated with the university. The history of both schools went back many years to the days of Daniel Drake, and the rivalry between the two faculty groups continued after the merger.

The introduction of new ideas, especially in preclinical teaching and research, was needed, and Knower was one of a group of four men brought in from without to accomplish this purpose. The plans called for the construction of a complete new plant, both hospital and laboratories, which was carried through under the general leadership of the late Dr. Christian Holmes. Knower's part was to plan and equip the new anatomical laboratory, and this he did with vision and skill. He had brought with him from Baltimore the spirit of Mall's laboratory at Johns Hopkins, and this was reflected in the organization and atmosphere of the department. Such fundamental changes could not be carried through undisputed. Controversies that would not abate arose over methods of teaching, the value of research, and standards for students. Knower, always persistent and uncompromising in matters of principle, would not yield, and the friction that developed led in the end to his resignation, an occurrence which could and should have been avoided. Nevertheless, this transitional period was a constructive one, and in spite of the difficulties and the unfortunate ending it was a very happy one in his life.

Knower was one of those teachers who treated his students as individuals and not simply as members of a class. He was not a facile lecturer and the inspiration that he gave them was not through this medium. It was rather by close personal contact in the laboratory and by his sympathetic understanding of their problems that he won their warm regard and affection.

To his friends and associates he was loyal and true, companionable and sympathetic, with a sense of responsibility in all his relations. His humor, cheerfulness and good nature gained him many friends, especially among the younger generation. In his years of declining health, which were long and distressing, these qualities never failed him. His courage and determination in completing a substantial part of his life work during this period of adversity will remain as an example to all who knew him.

ROSS G. HARRISON

NATIONAL RESEARCH COUNCIL,
WASHINGTON, D. C.

RECENT DEATHS AND MEMORIALS

DR. CARL L. ALSBERG, director of the Food Research Institute and of the Giannini Foundation of Agricultural Economics at Stanford University, died on November 1 at the age of sixty-three years.

DR. JOHN RENSHAW CARSON, research mathematician at the Bell Telephone Laboratories, New York, died on October 31. He was fifty-four years old.

DR. ORMOND R. BUTLER, since 1912 professor of botany and botanist in the Agricultural Experiment Station of the University of New Hampshire, died on October 24 at the age of sixty-three years.

DR. WILLIAM GOGGIN CROCKETT, professor of pharmacy at the Medical College of Virginia, died on October 29 at the age of fifty-two years.

DR. GUSTAVUS AUGUST EISEN, from 1893 to 1900 curator of the California Academy of Sciences, known for his work in biology and archeology, died on October 29 at the age of ninety-three years.

THE REV. DR. JOSEPH J. WILLIAMS, professor of cultural anthropology at Boston College, died on October 28 at the age of sixty-four years.

DR. ROBERT BOWIE OWENS, electrical engineer, secretary of the Franklin Institute from 1910 to 1924 with the exception of the war years, died on November 2 at the age of seventy years. He was formerly director of the Bartol Research Foundation.

M. EDOUARD CLAPARÈDE, professor of psychology at the University of Geneva and permanent secretary of the International Congress of Psychology, died on September 2. During recent years he had specialized in child psychology and had established the J. J. Rousseau Corresponding Institute of France. He was an honorary member of the British Psychological Society.

DR. ADOLPHO LUTZ, of the Oswaldo Cruz Institute of Rio de Janeiro, author of medical, zoological and entomological works, died on October 6 at the age of eighty-four years.

THE W. S. Blatchley Club, formerly the Hamilton County Nature Study Club, held a memorial meeting on October 11 for the late Dr. Blatchley, formerly State Geologist of Indiana, for whom the club was named. The meeting was held at Noblesville and the memorial tribute was given by Dr. J. J. Davis, of Purdue University.

THE *Journal* of the American Medical Association states that friends of the late Dr. Lawrason Brown, for many years head of the Trudeau Sanatorium, Saranac Lake, N. Y., have established the Lawrason Brown Memorial Fund to finance one or more fellowships for research in diseases of the chest. The fund will be managed by the Saranac Lake Society for the Control of Tuberculosis, and if at any time that organization should cease to exist the management of the fund will be offered first to the Johns Hopkins University. The present committee is composed of Drs. Leroy U. Gardner and James Woods Price, Saranac Lake; Louis Hamman, Baltimore; Esmond R. Long, Philadelphia; David R. Lyman, Wallingford, Conn., and William P. Thompson, New York.

SCIENTIFIC EVENTS

THE U. S. WEATHER UNIT AT HARVARD

THE United States Weather Bureau on November 1 moved its headquarters for regular observing of the sun's radiation from Washington, D. C., to the Blue Hill Meteorological Observatory of Harvard University, in Milton, Mass.

Two government technicians and government solar observation equipment will henceforth be located at the Harvard station. Weather bureau instruments for solar observation will be calibrated at the Harvard station, and the routine solar reports of other government observatories will be received and edited there.

Harvard's observatory has been carrying on study of the intensity of solar radiation for eight years, initiated by Dr. Herbert H. Kimball, research associate, who retired from the government Weather Bureau in 1932, and from Harvard last year.

Solar observations made at the Harvard weather station include measurement of the intensity of solar radiation on a horizontal plane and on a plane perpendicular to the sun's rays, and also study of the dust and moisture content of the atmosphere. The observations are important in weather forecasting and also for increasing knowledge about the sun and the earth's atmosphere.

Professor Charles F. Brooks, director of the Harvard weather station, explains that in moving solar observation headquarters to the Harvard station the government weather officials considered both the advantageous observing conditions on Blue Hill, relatively free from city smoke; and also the intensive studies of solar radiation being carried on in this region by both Harvard and Massachusetts Institute of Technology under the auspices of foundations established by Dr. Godfrey L. Cabot, Harvard, 1882, of Boston.

The government technicians at Blue Hill will be Irving F. Hand and Mrs. Helen Cullinane, now of the Washington Bureau.

THE CANAL ZONE BIOLOGICAL AREA

A MOVE to put the research laboratory on Barro Colorado Island on a permanent basis was successful when the act was passed directing the President of the United States to set aside within the Canal Zone an area in Gatun Lake known as Barro Colorado Island in which the natural features shall, except in event of declared national emergency, be left in their natural state for scientific observation and investigation, the area to be known in the future as the Canal Zone Biological Area. The act provides for a Board of Directors to consist of the Secretary of War, the Secretary of Agriculture, the Secretary of the Interior, the Secretary of the Smithsonian Institution, the president of the National Academy of Sciences and three distinguished biologists appointed by the president of the National Academy of Sciences with the approval of the Secretaries of War, Agriculture, Interior and the Smithsonian Institution; the president of the academy to be chairman of the board and the secretary of the Smithsonian Institution to be vice-chairman. The Act also authorized an appropriation not to exceed $10,000 each year as a contribution toward the expenses of running the laboratory.

Since the passage of the Act three biologists, Dr. Thomas Barbour, director of the Museum of Comparative Zoology at Harvard College; Dr. Elmer D. Merrill, director of the Arnold Arboretum of Harvard University, and Dr. Alexander Wetmore, assistant secretary of the Smithsonian Institution and director of the U. S. National Museum, have been appointed members of the board as provided by law, the President of the United States formally carrying out, under an Executive Order, the direction of Congress setting aside the Canal Zone Biological Area.

The first annual meeting was held on October 7 and the next annual meeting will be held on May 1, 1941.

THE LALOR FOUNDATION

THE Lalor Foundation has announced the program of its fifth series of fellowship awards in chemistry for the academic year 1941–42. Four post-doctorate awards of a value of $2,000 each and two awards of $2,500 each have been authorized. They are open to both men and women. The recipient of an award must have the equivalent of a Ph.D. degree and the applicants will be judged by their previous training, demonstrated competence and promise in their special fields of work.

The six fellowship awards have been assigned one each to the following chemists notable for their leadership in research: Dr. Roger Adams, University of Illinois; Dr. Hans Clarke, Columbia University; Dr. Frederick G. Keyes, the Massachusetts Institute of Technology; Dr. Charles A. Kraus, Brown University; Dr. Arthur B. Lamb, Harvard University; Dr. E. K. Marshall, the Johns Hopkins University Medical School. Each of these men will have the responsibility for selection of the holder of the award at his respective institution.

Detailed information and application forms may be obtained by addressing C. Lalor Burdick, secretary of the Lalor Foundation, Wilmington, Del., or by direct communication with the above-named men. Applications should be filed before December 31. Appointments will be announced early in 1941.

THE ADMINISTRATION OF THE E. R. SQUIBB AND SONS AWARD

In order to promote interest in researches dealing with endocrinology, E. R. Squibb and Sons have established an annual award of $1,000 to be given through the medium of the Association for the Study of Internal Secretions. The association, through an appropriate committee of judges selected from its membership, will name the recipient of this award; the formal presentation of it will be made as part of the annual meeting program.

The award will be given to the research worker in the United States or Canada who, in the opinion of the judges, has published during the previous calendar year the most meritorious scientific report dealing with the field of the hormones. While it will be given primarily for publication of specific papers, the judges will be given considerable latitude in the exercise of their function. If in their judgment circumstances and justice so dictate, it may be recommended that the prize be divided between two or more persons. It may also be recommended that it be made to a worker for valuable contributions over an extended period but not necessarily representative of a given year. Membership in the association is not a requisite of eligibility for the award.

A committee of judges consisting of five members of the association will be appointed annually by the president to recommend to the council a recipient for the award. To assist this committee in its deliberations nominations will be solicited by the secretary of the association by means of public announcements and by a note in the annual letter to members. Such nominations may be sent to the secretary at any time for transmissal to the Committee of Judges. For a nomination to be considered for the award to be bestowed at any given spring meeting of the association, however, it must be received by the secretary not later than January 15. The nomination should be accompanied by such data relative to the nominee and his research as will facilitate the task of the committee in its consideration of the nomination. In addition to the investigation of the merit of nominations thus made, it will be the duty of the committee to search the literature on its own account in arriving at its selection of a recipient for the award. The personnel of the committee will be kept confidential until its deliberations are finished.

The name of the nominee selected by the committee should be sent to the secretary of the association as soon as possible after January 15. This nomination will then be submitted to the council for ratification and thereafter the nominee will be notified in order that he may make plans for being present at the annual meeting. The name of the nominee will be kept confidential by all concerned until the announcement is made at the annual dinner, at which time the award will be bestowed by the president of the association. The recipient will be expected to make a brief response.

It is a very definite desire of both the donor and the council that the award be made annually. In accepting the award, the council specified that the field covered should be broad enough so that there should be no question about finding a meritorious contribution and recipient annually. It is understood, however, that the association will not be expected to make the award for definitely mediocre work. Thus, the council is prepared to consider the withholding of the award in any given year if it is the carefully considered judgment of the committee that this should be done.

In addition to the purse provided by E. R. Squibb and Sons the recipient will be presented with a simple scroll as a memento of the occasion, the cost to be defrayed by the association.

THE PERMANENT SCIENCE FUND OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES

Income from the Permanent Science Fund, according to agreement and declaration of trust, shall be applied by the American Academy of Arts and Sciences to such scientific research as shall be selected ". . . in such sciences as mathematics, physics, chemistry, astronomy, geology and geography, zoology, botany, anthropology, psychology, sociology and economics, history and philology, engineering, medicine and surgery, agriculture, manufacturing and commerce, education and any other science of any nature or description, whether or not now known or now recognized as scientific, and may be applied to or through public or private associations, societies, or institutions, whether incorporated or not, or through one or more individuals."

Applications for grants are considered by a committee of this academy on stated dates only. The next meeting to consider applications will be held on February 15, 1941. Applications should be made on special forms furnished by the committee. Correspondence, including requests for application blanks, should be addressed to the chairman of the Committee on the Permanent Science Fund, Professor John W. M. Bunker, the Massachusetts Institute of Technology, Cambridge, Mass. Grants-in-aid from this fund were voted by the academy on October 9, as follows:

To Lloyd R. Watson, professor of chemistry, Alfred University, New York, for expendable materials and for assistance in a continuation of his study of eye colors of mutant bees, $450.

To Edward H. Kemp, assistant professor of psychology, Duke University, for rebuilding an amplifier system to be used in recording impulses from single fibers of the eighth nerve, $250.

To Dr. Daniel Abramson, assistant in obstetrics, Boston Lying-In Hospital, for chemicals, animals and other expendable materials to be used in a study of the effect of "Relaxin" on smooth muscle, $300.

To Lyman G. Parratt, assistant professor, Cornell University, for equipment and construction of high voltage apparatus for a continuing study of the outer energy levels of solid materials, $325, contingent upon receipt by the recipient of a similar sum from the Rumford Committee or elsewhere.

To Charles W. Turner, professor of dairy husbandry, University of Missouri, for the purchase of experimental animals and feed for a study of the relation of thyroid gland to the fat, carbohydrate and protein metabolism hormones of the anterior pituitary, $500.

To George E. Valley, Jr., national research fellow, Harvard University, for machine work, metal stock, materials and specimens required in his study of the energy and relative intensity of gamma rays from certain atomic nuclei, $450.

To Donald H. Menzel, professor of astrophysics, Harvard University, for the purchase of quartz plates and other materials to construct filters for isolating narrow bands of light to be used in astronomical studies, $450.

To Alfred C. Lane, professor emeritus of geology, Tufts College, to supply certain materials and assistance to Professor Wahl, of Helsinki, Finland, as a part of the program of the Committee on the Measurement of Geological Time of the National Research Council, $250, provided that means can be found to forward materials and funds to the above destination.

To Alvin L. Moxon, experiment station chemist, South Dakota State College, Brookings, South Dakota, for materials and animals to be used in his investigation of the antagonism between arsenic and selenium as it relates to selenium poisoning of livestock, $300.

To Martin D. Whitaker, instructor of physics, New York University, a final grant for the rental of a radium beryllium source to continue his investigation in slow neutron scattering which was supported from this fund in the calendar year just completed, $500, contingent upon the applicant's ability to secure $350 from some other source.

To Hugh M. Huffman, assistant professor of biochemistry, California Institute of Technology, for construction of a semimicro bomb to be used in his continuing studies of the application of thermodynamics to physiological processes, $400, contingent upon his assurance that funds will be available for the remainder of the cost of the problem outlined by him.

To James A. Beattie, professor of physical chemistry, of the Massachusetts Institute of Technology, a final grant for materials and construction of a cryostat to cover the temperature range 0° to $-270°$ C. to be used in his studies in the absolute temperature scale from $-270°$ to $+450°$ C., $500.

THE CHEMICAL EXPOSITION

An Industrial Chemical Conference will be held in connection with the National Chemical Exposition from December 11 to 15 at the Stevens Hotel in Chicago. At this conference new discoveries and developments in the service of chemistry and its application and progress in many fields of activity will be discussed.

Announcement is made that the directors of the exposition, sponsored by the Chicago Section of the American Chemical Society, believe that its objectives may be enhanced by furnishing the latest scientific information as well as the practical education that will result from a visit to the exhibition.

Dr. R. C. Newton, chairman of the exhibition committee, states:

> We have arranged for this Industrial Chemical Conference an excellent program of papers in the nature of symposia on "Newer Developments in Chemistry and Chemical Engineering." The program is timed to afford those who wish to hear the talks in which they are interested ample opportunity also to view the show.

Technical sessions for the conference have been arranged for Thursday afternoon and evening, December 12; Friday morning, December 13, and Saturday afternoon, December 14. The regular monthly meeting of the Chicago Section of the American Chemical Society will be held on Friday evening, December 13.

Dr. Newton states that in addition to speakers there will be a number of new films shown on a variety of subjects. It is planned to set aside a room for the frequent showing of films that should be of interest to those attending the exposition.

The committee estimates that approximately 40,000 chemists will attend the exposition and conference, including chemists, chemical engineers, operating engineers, production managers, plant superintendents, buyers and company executives. Exposition floor space is limited to 38,000 square feet, more than 75 per cent. of which has already been assigned.

SCIENTIFIC NOTES AND NEWS

The Sedgwick Memorial Medal of the American Public Health Association has been awarded posthumously to Dr. Hans Zinsser.

The American Geographical Society has awarded the Cullum Geographical Medal to Dr. Robert Cushman Murphy, curator of oceanic birds at the American Museum of Natural History, and the Charles P. Daly Medal to Professor Carl O. Sauer, chairman of the department of geography at the University of California. The presentation will be made at a meeting of the society to be held in New York on December 20.

THE John Fritz Medal for 1941 has been awarded to Ralph Budd, president of the Chicago, Burlington and Quincy Railroad, for "the improvement of railroad tracks and service, especially the introduction of light-weight streamlined trains." The medal was established in 1902 in memory of John Fritz, who had distinguished himself in improving methods for the manufacture of steel. The board of award is composed of sixteen representatives of the four national societies of civil, mining and metallurgical, mechanical and electrical engineers. The medal will be presented to Mr. Budd at a dinner late in December or early in January.

AT a joint meeting in Urbana, Ill., on November 9, of the Midwest, Central and Cincinnati Sections of the American Association of Cereal Chemists a presentation will be made to Past President George Garnatz, of the Kroger Food Foundation, for his year of service in office. The national president, Claude Davis, of the Noblesville Milling Company, will describe Mr. Garnatz's work, after which Dr. C. H. Bailey, of the University of Minnesota, will make the presentation. Dr. J. H. Shollenberger, of the Northern Research Laboratory of the Department of Agriculture, will speak on "Production and Utilization Aspects of the Wheat Situation."

DR. WILLIAM J. KERR, professor of medicine in the School of Medicine of the University of California, formerly president of the American Rheumatism Association, has been elected an honorary member of the Liga Argentina contra el Reumatismo of Buenos Aires.

THE *Journal* of the American Dental Association reports that at the annual meeting in Cleveland on September 10 the entire day was set aside as "Harvey J. Burkhart Day" in honor of Dr. Burkhart, director of the Rochester, N. Y., Dental Dispensary and of the Eastman Clinics in Europe. Dr. Burkhart was guest of honor at a luncheon in the Hotel Statler, attended by more than a thousand colleagues and friends.

DAVID KEYNES HILL, the son of Dr. A. V. Hill, Foulerton research professor of physiology and secretary of the Royal Society, London, has been elected a fellow of Trinity College, Cambridge, in recognition of his research in physiology.

OFFICERS of the Society of American Bacteriologists have been elected as follows: *President,* Dr. M. L. Isaacs, professor of sanitary science at Columbia University; *Vice-president,* Dr. Edw. J. Keegan, of the department of bacteriology of St. Johns University; *Secretary-treasurer,* Dr. Carroll Grant, professor of bacteriology at Brooklyn College; *Councilor,* Dr. Nicholas Kopeloff, professor of bacteriology at Columbia University.

DR. NORMAN H. CEAGLSKE, of the State University of Iowa, has been appointed assistant professor of chemical engineering at Washington University, St. Louis.

EDWIN D. MCKEE, naturalist of the Grand Canyon National Park and a research associate of the Carnegie Institution of Washington, has been appointed director of the Museum of Northern Arizona. He will join the museum staff on January 1.

FREDERICK G. SWITZER, professor of mechanics and hydraulic engineering and head of the department of mechanics in the Sibley School of Mechanical Engineering of Cornell University, has resigned to become a division engineer with the New York City Board of Water Supply. He will be succeeded at Cornell by Dr. James N. Goodier, who joined the faculty in 1938 as professor of mechanics.

A. M. BUSWELL, professor of chemistry at the University of Illinois, has been appointed the representative of the American Chemical Society on the advisory committee of the U. S. Public Health Service for the Revision of Drinking Water Standards.

DR. J. BURNS AMBERSON, JR., professor of medicine at the College of Physicians and Surgeons, Columbia University, has become a member of the committee on medical education and of the committee on medical research of the National Tuberculosis Association.

ASSISTANT PROFESSOR D. W. KERST has leave of absence from the department of physics of the University of Illinois until September, 1941, for the purpose of developing his induction accelerator in the research laboratory of the General Electric Company.

DR. FREDERICK S. HAMMETT and the statistical staff of the Lankenau Hospital Research Institute will be located at Fiddlers Point, Grenada, Sarasota, Florida, for the winter. The mail address is P. O. Box 347, Sarasota, Fla.

JOSEPH F. ROCK has resigned from a position as research associate in the University of Hawaii because of dissatisfaction on his part with facilities for storage and display of his collection of Chinese books and art objects, some of which had been presented conditionally to the university and the remainder deposited on indefinite loan. Because of his feelings in the matter, the collection has been released to him. He has now returned to China to continue his studies of ancient manuscripts on which he has been working for some years.

THE *News Edition* of the American Chemical Society states that G. C. Crooks, assistant professor at the University of Vermont, secretary of the Western Vermont Section of the society, has been granted leave of absence in order to accept a call to active duty in the Chemical Warfare Service. For the present he will serve as liaison officer between the offices of the Assistant Secretary of War and the Adjutant General of the State of Vermont.

THE second Barnard Hospital lecture will be given on November 19 by Dr. Carl Voegtlin, chief of the National Cancer Institute, in the auditorium of the St. Louis Medical Society. His subject will be "Possibilities of Improved Therapy for Cancer Patients."

DR. ANDREW C. IVY, Nathan Smith Davis professor of physiology and pharmacology and head of the department at the Medical School of Northwestern University, will give the eighth E. Starr Judd lecture at the University of Minnesota on January 15. The subject of the lecture will be "The Mechanisms of Gastric Secretion."

PROFESSOR JOHN T. BUCHHOLZ, head of the department of botany at the University of Illinois, gave a Graduate College lecture at the State University of Iowa on October 14 on "Genetics of Pollen-tube Growth in *Datura.*"

THE Salmon Memorial Lectures will be delivered at the New York Academy of Medicine on the evenings of November 8, 15 and 22 by Dr. Nolan D. C. Lewis, director of the New York Psychiatric Institute and Hospital and professor of psychiatry at Columbia University. The titles of the individual lectures are "Historical Perspectives of Psychiatric Thought," "Modern Ramifications in Psychiatric Thought and Research" and "Prospects for Future Achievement in Psychiatric Research."

THE Hume Cronyn Memorial Observatory of the University of Western Ontario, London, was dedicated on the afternoon of October 25. Greetings from sister observatories and universities were conveyed by Dr. C. A. Chant, director emeritus of the David Dunlap Observatory of the University of Toronto, and by Dr. S. A. Mitchell, director of the Leander McCormick Observatory of the University of Virginia. At the convocation exercises held the same evening, Professor Mitchell was awarded the degree of doctor of laws and gave the address entitled, "Astronomers and Their Telescopes."

APPLICATIONS for the Benjamin Peirce instructorships in mathematics at Harvard University for the year 1941–42 should be sent to the chairman of the department of mathematics. Candidates should have received the doctorate or have done equivalent work.

THE endowment of the Arnold Arboretum of Harvard University has been increased by two recent bequests amounting to $35,932. Of this, $12,880 was from the estate of Miss Grace L. Edwards, and $23,054 from the estate of Mrs. James G. Freeman, the latter to be added to the Laura Lucretia Case Fund.

THE General Education Board has added $12,700 to the grant previously made to the Brush Foundation of the School of Medicine of Western Reserve University for the study of child health and development under the direction of Dr. William Walter Greulich, professor of physical anthropology and anatomy and director of the foundation.

THE Rockefeller Foundation has given £1,000 to the Royal Society of Medicine for the preservation of its library. It is proposed to evacuate to a suitable house a number of the older and irreplaceable periodicals. A member of the library staff will accompany them and will be in telephonic communication with the library in London.

THE University of California at Los Angeles has undertaken to train meteorologists for the U. S. Weather Bureau, the United States Navy and the United States Army. Fellowships are being offered by the Government to students of graduate standing. The work in meteorology will be offered under the direction of Dr. J. Bjerknes, formerly of Bergen, Norway, and Dr. J. Holmboe, of the Massachusetts Institute of Technology. Additional courses in thermodynamics, mathematics, mechanics and astrophysics will also be offered in the program.

SIXTY-FIVE educational institutions have been accredited for chemistry instruction by the Committee on the Professional Training of Chemists of the American Chemical Society, of which Professor Robert E. Swain, of Stanford University, is chairman. The list includes only those institutions of which the committee has been able to make a careful study up to the present time. According to the report, the need for more thorough training in chemistry not only in academic work but in control, development and research in the chemical industries has become particularly apparent in the last two decades. During the depression, the striking fact, of utmost importance to the chemical profession, was uncovered that a large proportion of those in the list of unemployed chemists did not qualify, by training or experience, to hold chemical positions. The American Chemical Society is striving to improve the profession of chemistry. It is fundamental to such a program that the training and experience necessary for a man who is to be called a chemist to be recognized and at least in broad terms specified.

THE *E. W. Scripps,* the research vessel of the Scripps Institution of Oceanography at La Jolla, is now in the Gulf of California on a three-months scientific cruise. The trip is sponsored jointly by the University of California and the Geological Society of America. Its object is to study the sediments and geology of the bottom of the gulf. Four principal areas will be investigated in detail and soundings will be taken at other points. Dr. Francis P. Shepard is a member of the expedition.

The American Association of Dental Editors, composed of the editorial staffs of non-proprietary dental journals, is considering a plan to develop means for the abstracting of all articles published in their respective journals. They propose that the editors of individual dental journals agree to furnish and pool abstracts of all articles which they publish. These will be offered to some large group, such as the American Dental Association, for publication.

According to *Nature* the Geographical Department of the Northern Sea Route Administration (USSR) has sent out the icebreaker *Sedov* on a new expedition to the northeastern part of the Kara Sea. It will be remembered that the *Sedov* returned to Murmansk on January 29, 1940, after a remarkable drift in the Arctic of twenty-seven months duration. The head of the new expedition is V. I. Vorobyev. The purpose of the expedition is to study one of the most important parts of the Northern Sea Route in the Kara Sea—from Izvestia Tsik Islands to Russky Island. The total length of this part is about two hundred nautical miles. The expedition is to carry out hydrographic and hydrological research: it will make systematic soundings of the depths of the sea, study the currents, wind régime, ice conditions and will carry out magnetic observations.

DISCUSSION

ON THE THEORY OF THE SEPARATION OF ISOTOPES BY THERMAL OR CENTRIFUGAL METHODS

The theory of the separation of the components of a fluid by the thermal process has been discussed in detail by Waldmann, Furry, Jones and Onsager and Debye.[1] The importance of the process has been greatly enhanced by the striking success of its use in the separation of the isotopes of the elements. With this success has come a demand for a more complete knowledge of the functioning of the apparatus for a greater variety of types of gas flow than vertical thermal convection; the calculations of the investigators, mentioned above, were limited to this case. With the realization that similar processes are applicable to the centrifugal method,[2] it seemed that the same general method which will be described in detail in this paper for the thermal case could be applied profitably to that very interesting problem. The results of the calculations for both these cases will be compared in this note. However, the conclusions will be restricted to those systems which have been in operation for a period of time sufficiently long that they have nearly reached a state of equilibrium. For simplicity, a two-dimensional system will be considered in which the mass motion in the fluid is in the direction of the z-axis, and in which the primary effect, either thermal diffusion resulting from a temperature gradient between the walls, is in the x-direction, or that diffusion resulting from a centrifugal field gradient, is radial in the r-direction. It will be convenient to consider a fluid composed of two components with masses m_1 and m_2 and with concentrations c_1 and c_2 respectively. For the thermal case the equation of equilibrium can be expressed, for example, for the first component in the form

$$-\rho v \frac{\partial c_1}{\partial z} + \rho D \frac{\partial^2 c_1}{\partial z^2} + \frac{\partial}{\partial x}\left[\rho D \left(\frac{\partial c_1}{\partial x} - \alpha \frac{c_1 c_2}{T} \frac{\partial T}{\partial x}\right)\right] = 0 \qquad (1)$$

in which the second term

$$\rho D \frac{\partial^2 c_1}{\partial z^2}$$

can be dropped if the total change in the concentration of the first component is small compared to its initial concentration. This equation is subject to the boundary condition that at $x = 0$ and $x = d$,

$$\frac{\partial c_1}{\partial x} - \alpha \frac{c_1 c_2}{T} \frac{\partial T}{\partial x} = 0$$

and that the net flow across any plane perpendicular to the z-axis is zero, *i.e.*,

$$\int_0^d (\rho v)\, dx = 0, \text{ for all values of } z. \qquad (2)$$

To complete the mathematical formulation of the problem the equation must be added which expresses the condition that across any plane perpendicular to the vertical axis the transport of component, one, resulting from diffusion and mass motion must be in equilibrium.

$$0 = \int_0^d \rho \left(-D \frac{\partial c_1}{\partial z} + v c_1\right) dx$$

for all values of z. To the approximation that all changes in c_1 are small compared to its initial value this equation gives for a column of height, h,

$$\frac{\Delta c_1}{h} D \rho_0 d = -\int_0^d \int_0^x \rho v\, dx \left(\frac{\partial c_1}{\partial x}\right) dx \qquad (3)$$

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[1] Waldmann, *Zeits. f. Physik*, 114: 53, 1939; Furry, Jones and Onsager, *Phys. Rev.*, 55: 1083, 1939; Debye, *Ann. d. Physik*, 56: 284, 1939.

[2] Beams and Skarstrom, *Phys. Rev.*, 56: 266, 1939. U. S. Patent Application, ser. no. 268352, 1939.

where ρ_0 is the average density of the medium. Now the equation for thermal diffusion can be written to a first approximation as

$$\rho_0 D \frac{\partial c_1}{\partial x} = \rho_0 D \alpha \frac{c_1 c_2}{T\,av.} \frac{\Delta T}{d} - \frac{\Delta c_1}{h} \int_0^x (\rho v)\, dx \qquad (4)$$

where ΔT is the temperature difference between the walls and $T\ av.$ is the average temperature of the enclosure. The substitution of (4) in (3) gives for the thermal case

$$\frac{\Delta c_1}{h} = \frac{-\dfrac{\alpha c_1 (1-c_1)}{\rho_0 D d^2} \dfrac{\Delta T}{T\,av.} \displaystyle\int_0^d \int_0^x \rho v\, dx.\quad dx}{1 + \dfrac{1}{\rho_0^2 D^2 d} \displaystyle\int_0^d ([\int_0^x \rho v\, dx]^2) dx}$$

as the equation for the determination of the total change in concentration Δc_1, along the column.

This equation has a number of simple properties: (1) For any given distribution of ρv consistent with equation (2) the value of Δc_1 can be determined by quadratures. (2) The total change in concentration varies directly as the height h of the column. (3) The change in concentration Δc_1 for a column of fixed height h has a maximum value for a definite value of d, the width of the column. For the case where the mass motion is that of thermal convection, *i.e.*,

$$\rho v = \rho_0 v_0 \frac{x}{d} (x - d/_2)(d - x)$$

the position of the maximum computed in this way agrees to within 3 per cent. with Waldmann's value. (4) The last two results are well known. The new and interesting conclusions concern the changes produced in these results by varying the character of the vertical mass motion such as may be accomplished by the appropriate use of baffels or other suitable mechanical means.[3] For the same transport of fluid across one half of the transverse section of the apparatus, the maximum in the value of Δc_1 as a function of d, occurs for certain velocity distributions at a smaller value of d—besides that the maximum value of Δc_1 is greater—the closer the maximum values of the velocity occur to the boundary $x = 0$ and $x = d$. (5) Similar results to those stated above in (1), (2) and (3) can be calculated for a centrifuge operating at a frequency f with an appropriate mass motion of the fluid circulating in the direction of the axis of rotation of length h. The type of gas motion seems to be rather critical as these calculations show that not all types of circulation in the direction of the axis lead to an appreciable increase in the separation factor. Some idea of the relative optimum operation of the thermal and centrifugal separator respectively can be gained by comparing the relative values of the maximum of $\Delta c_1/h$ as a function of the width d. As the width d of the centrifuge is defined the effective radius. For these two distinct types of apparatus the ratio of the maximum of $\Delta c_1/h$ is as the ratio of the static effects. By static effect is meant the change in concentration arising from either thermal diffusion or centrifugal diffusion without any accumulative effect from the circulation in the fluid. It is interesting to note, however, that the calculations predict that for the centrifugal case the transport of fluid across one half of the transverse section of the apparatus, such as may be produced by thermal means in a centrifuge of proper pitch, should be nearly the same per unit area as that of the thermal separator with the circulation produced by thermal convection when both apparatuses are operating under optimum conditions, with the same values for the pressure of the gas and the width of the apparatus.

ARTHUR BRAMLEY

WASHINGTON, D. C.

THE STANDARDIZATION OF OSMOTIC PRESSURE AS A TERM

IN physical chemistry osmotic pressure has a long-established meaning: a physico-chemical property of a solution. Any definitions of osmotic pressure should not conflict with this. Confining ourselves to aqueous solutions we may say that osmotic pressure measures the difference of the fugacity of water between that in pure water and that in water acting as the solvent in a solution. This difference in fugacity is more or less proportional to the solute concentration, so that this difference, and hence the osmotic pressure, increases with increasing solute concentration. Osmosis is diffusion of water. Water diffuses from regions of high water fugacity (pure water) to regions with lower water fugacity (solution). Hydrostatic pressure is enhanced in turgid cells; an increase in hydrostatic pressure increases the fugacity of water, *e.g.*, vacuolar water. Since this pressure increases water fugacity the difference between the fugacity of water in the solution under pressure and that of free pure water is diminished and the effective or actual osmotic pressure is also diminished. Cells in water equilibrium have no residual actual or effective osmotic pressure, although the same fluid under no excess pressure would have the osmotic pressure given by its composition. This view obviates the desire for such terms as suction pressure. Suction pressure is the residual effective osmotic pressure when the cell contents are under pressure insufficient for equilibrium.

The definition proposed by Eyster[1] seems to consider that some quantity parallel to fugacity of water should be termed osmotic pressure. He says, "The osmotic pressure of water in the vacuole of a plant cell is increased by turgor pressure and decreased by the solute concentartion of the cell sap." But physical chemistry, the underlying discipline, teaches that pressure (including turgor pressure) *decreases* the osmotic pressure of solutions, while increased concentration *increases* it.

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[3] Brewer and Bramley, *Jour. Chem. Phys.*, 7: 972, October, 1939; Bramley and Brewer, *Jour. Frank. Inst.*, March, 1940 (Bartol Notes).

[1] H. C. Eyster, SCIENCE, 92: 171, 1940.

It is to be hoped that botanists generally will recognize the perfectly clear relations furnished by physical chemistry.

S. C. Brooks

University of California

EQUINOXES AND SOLSTICES

According to Science of September 13, 1940, any implication that the equinoxes and the solstices mark the beginnings and the ends of the seasons riles Professor Sleator, of the University of Michigan, up one side and down the other. He reminds one of the Iowa farmer who "cussed" for a month on receiving by express from a Scotchman a yearling sheep when he had ordered a fine hog. Of course the ruckus between these two honest men was all because to the one "hog" meant a grown-up pig, and to the other a grown-up lamb. So it is with the term "summer." As commonly used it means, even to the astronomer, the warmest season of the year, without, though, a definite time for either beginning or ending as defined by statute or set by common agreement. If, however, we so divide the year into four approximately equal periods that one shall be as much as possible the warmest of all, and call it summer, then throughout most of the northern hemisphere summer would roughly coincide with the three months which together there generally are called summer, namely, June, July and August. The like months in the southern hemisphere, are, of course, December, January and February.

But all this, though sufficient for our everyday needs, is lacking in precision. It does not have that satisfying exactness that pertains to each of the four quarters of the year proposed by astronomers more than two thousand years ago, that is, the periods delimited by the equinoctial and solstitial instants—the two times when the center of the sun is in the plane of the earth's equator and the two times when it is farthest therefrom. One of these periods, the one that runs from about the 22nd of June to the 23rd of September, astronomers call the summer quarter, or summer, for short. Here, as in so many other cases, the scientist just took a loosely used everyday word and changed it into a technical term by giving to it a meaning that is exact, however much or little it may differ from that of the original.

To say that summer begins at the moment of summer solstice and ends at the moment of autumnal equinox is to talk in the same breath astronomical good sense and agricultural nonsense. What, then, shall we do about it? Nothing. So long as it sounds newsy to say that summer began at such or such a particular hour and minute of a certain night, for instance, the papers will just keep on saying it that way. It is up to the reader, as we say, to recognize the fact that the summer in question is not the vaguely determined period in which the local vegetation flourishes, and therefore different for different regions, but that exact period which the astronomer has arbitrarily called summer.

When buying a hog, sight unseen, be certain what sort it is, sheep or pig. Similarly, when we read of summer beginning at a certain minute on the 22nd of June, we have only to remember that this is summer in the technical sense, as the astronomer defines it, and not summer as we personally experience it. Perhaps, though, the annual repetition of this confusion by the papers is not a bad thing, after all, for it does afford occasions for spreading a bit of interesting astronomical information at times when it is likely to be welcome.

W. J. Humphreys

U. S. Weather Bureau,
Washington, D. C.

REFERENCE CITATIONS AND MICROFILM

The value of the Bibliofilm Service of the U. S. Department of Agriculture and the Medicofilm Service of the Army Medical Library to the worker located away from large libraries is well known. One using such service soon realizes that certain methods of listing references are more useful than others, both to the worker and to the microfilm service.

The best type of reference cites the author, year, title, journal, volume, first and last pages. Some journals omit the title or the last page or both. Usually the nature, and consequently the desirability, of a paper can be determined by the title. Also, omitting the title results in the wrong article being copied if the page listings are in error. If the last page number is omitted, the length of the article can not be determined. It is valuable to know the length of the article for two reasons: (1) the decision can be made as to whether it is to be copied on microfilm or photostated; (2) the correct amount of money to cover the copying cost can be sent with the order, thereby simplifying the accounting. It is realized that complete listing of references might involve a small additional expense for some journals, but this should be more than offset by the increased value to the reader.

Martin D. Young
G. Robert Coatney

U. S. Public Health Service

SCIENTIFIC BOOKS

PROGRESS BY COOPERATION

The New Systematics. Edited by JULIAN HUXLEY. 583 pp. Oxford University Press. $6.00.

A GROUP of the best British cytologists, ecologists, geneticists and taxonomists convened in June, 1937, in Burlington House, London, in the rooms of the Linnean Society and founded an "Association for the Study of Systematics in Relation to General Biology" under the presidency of Julian S. Huxley.

The society, recognizing that the supremacy of the morphological methods in taxonomy had lasted long enough, aimed to bring together a large group of general and taxonomic biologists to study, not only how recent advances and discoveries in various branches of general biology could further taxonomy, but also how taxonomy could reciprocate this help (". . . daring the reproaches of his biological colleagues the taxonomist maintains that his subject is the alpha and has the potentiability of becoming the omega of a very considerable part at least of biological knowledge"—Turrill).

Many of the opinions expressed by the founders of the society are hardly original, most of them had been said better and years ago in Scandinavia and Germany. Yet the founding of the society may well be a milestone in the history of biology as it represents the first *large-scale organized cooperative effort* to get away from old-fashioned outlooks and methods in taxonomy.

The following list of chapters may give an idea of the scope of the society's first book:

W. B. TURRILL: Experimental and synthetic plant taxonomy (simple cultivation under approximately uniform conditions; under varied but controlled or known conditions; cytological experiments; genetical experiments).

N. W. TIMOFEEFF-RESSOVSKY: Mutations and geographical variation.

C. D. DARLINGTON: Taxonomic species and genetic systems (the role of structural change; the decay of sexual reproduction; genetic isolation; hybridity, phylogeny; etc.).

SEWALL WRIGHT: The statistical consequences of Mendelian heredity in relation to speciation.

H. J. MULLER: Bearings of the "Drosophila" work on systematics.

LANCELOT HOGBEN: Problems of the origins of species. ("There is no one problem of the origin of species. There are many problems of the origins of species.")

E. B. WORTHINGTON: Geographical differentiation in fresh waters with special reference to fish.

C. DIVER: The problem of closely related species living in the same area. ("The aim of taxonomy is more than the mere pigeon-holing of different organisms on some convenient but completely arbitrary system of card-indexing. It seeks to establish relationships, and to determine what degree of dissimilarity is consistent with placing two individuals within the same species.")

E. J. SALISBURY: Ecological aspects of plant taxonomy (interesting conclusions, *vide* pp. 358–361).

W. H. THORPE: Ecology and the future of systematics.

G. R. DE BEER: Embryology and taxonomy. ("Two little embryos in spirit, whose names I have omitted to attach, and at present I am quite unable to say to what class they belong. They may be lizards or small birds, or very young mammalia.")

W. J. ARKELL and J. A. MOY-THOMAS: Palaeontology and the taxonomic problem. ("The question 'What constitutes a species?' always so troublesome to the neontologist, hardly concerns the palaeontologist, since the more he learns of phylogeny the more arbitrary must be the distinctions he draws between his species. He is, in fact, torn between two irreconcilable endeavours; for as a phylogenist he strives to reveal closer and closer relationships, while as a systematist he must point out differences and divide up his material into units bearing distinct names.")

J. RAMSBOTTOM: Taxonomic problems in Fungi (summary of special mycological problems, p. 412).

T. A. SPRAGUE: Taxonomic botany, with special reference to the Angiosperms.

W. T. CALMAN: A museum zoologist's view of taxonomy. ("What is very remarkable and significant, however, in this constant influx of novelties, is the rarity of the unexpected. The diversity is indeed unending, but it runs in well-defined channels.")

J. S. L. GILMOUR: Taxonomy and philosophy. ("A number of questions connected with the theoretical side of their work which are by no means satisfactorily settled and . . . . these points of disagreement are frequently a hindrance to progress in taxonomic practice.")

JOHN SMART: Entomological systematics examined as a practical problem. ("Steps should be taken to prove the worthiness of systematics for recognition as a discipline by the academic world. The present objection to recognition would, possibly, be largely removed if systematists showed genuine signs of adopting real rational and scientific methods for the coordination and recording of their information, and the prosecution of their work. It is possible that these findings may have an application to a wider field than Entomological Systematics alone.")

E. B. FORD: Polymorphism and taxonomy.

H. H. ALLAN: Natural hybridization in relation to taxonomy.

M. B. CRANE: The origin and behaviour of cultivated plants. ("The taxonomist has generally regarded the study of cultivated plants with suspicion. He has tended, possibly on account of a false philosophical distinction between natural and artificial conditions, to ignore all cultivated plants as outside his discipline or as forming a secondary applied branch of it, namely, economic botany. The geneticist, on the other hand, following Darwin's example, has found convenient and useful material in cultivated plants and domestic animals, with their wealth of analysable varieties and frequent high fecundity in crosses.")

N. I. VAVILOV: The new systematics of cultivated plants. ("We regard classical systematics, which works only with Linnean species, as merely a first step in biological knowledge and quite superficial for the purposes of practical plant and animal breeding. Nor does it satisfy the requirements of a thorough study of species from an evolutionary point of view. We are now entering an epoch of differential, ecological, physiological and genetic classification. It is an immense work. The ocean of knowledge is practically untouched by biologists. It requires the joint labors of many different specialists—physiologists, cytologists, geneticists, systematists and biochemists. It requires the international spirit, the cooperative work of investigators throughout the whole world.”)

Dr. Julian Huxley, who edited the book, contributed a general introductory chapter, often critically summarizing the essential contents of subsequent chapters.

“The New Systematics” is the society's first large cooperative publication. It is not a manual that will help a young taxonomist anxious to start working along new lines with as simple indications as the morphologists and anatomists of one or two generations ago found in Strasburger or Chamberlain. It is much more a collection of discussions and essays which one will have to read, reread and compare to make the best use of. Most of us taxonomists, feeling as we all do that our methods resemble more those of the bibliographer than those of the accurate experimental scientist, will gladly make this effort and will be rewarded by discovering a volume as inspiring as Linné's “Philosophia” and De Candolle's “Phytographie.” Yet it carries another message. Linné (eighteenth century) taught us new methods of investigation and description; De Candolle (nineteenth century), in addition to these, new methods of documentation. The message of this twentieth century book is that taxonomy is going to be a field of cooperative research. This is important news for all who take the future of American science to heart, for nowhere in the world at present are conditions so suitable for large-scale cooperative research as in the New World.

The book shows better than any similar recent publication how the old taxonomist, who preferred the company of plants to that of men—the interesting figure of a generation ago, whose love for the *scientia amabilis* resulted very often from a desire to escape human society, will have to make place for another type of scientist anxious to cooperate and to organize collaboration with and between workers in many branches of general biology.

Julian Huxley on his last visit to this country urged the foundation of a society similar to the British society. May this book in the States be a stimulus to bring American taxonomists and general biologists closer together.

Frans Verdoorn

Farlow Herbarium,
Harvard University

SPECIAL ARTICLES

A CANCEROGENIC TISSUE EXTRACT FROM HUMAN SOURCES[1]

An extract has been prepared from the livers of persons who died of cancer which on subcutaneous injection into mice produced sarcomas at the site of injection.

In one experiment 9,420 grams of liver obtained from eight cases were extracted. These people had carcinoma of the stomach (three cases), carcinoma of the lung (two cases), carcinoma of the esophagus, pancreas, and rectum (one case of each). There were no carcinoma metastases visible in the livers grossly or microscopically.

The livers were ground and preserved in an equal volume of 95 per cent. alcohol. They were then saponified with alcoholic KOH for 24 hours in a steam bath, a volume of water equal to that of the alcohol in the mixture being added. The material was then extracted repeatedly with ethylene dichloride. This extract was evaporated to dryness at reduced pressure and the residue was resaponified. The final unsaponifiable residue so obtained was a flaky brown material with a disagreeable odor.

This residue was dissolved by warming with sesame oil. The oil has been tested repeatedly, unheated and after heating, and found not to be cancerogenic. About half a gram of extract dissolved in .5 cc of sesame oil was injected subcutaneously in 56 mice on June 1, 1939. The test of the potency of the extract was by no means quantitative because great but variable amounts were lost by sloughing at the site of injection. The mice used were of our own albino stock. They were of both sexes and were from 55 to 83 days old at the time of injection. Over two thousand mice of this stock have been used in a series of long-time experiments and a spontaneous spindle cell sarcoma has never been observed in them. The stock carries a small incidence of spontaneous mammary gland tumors, lymphatic diseases and lung tumors.

The first tumor appeared between five and six months after injection, and the mouse died on December 7, 1939, 182 days after injection. The tumor was large, measuring 33 × 25 × 22 mm. It lay in the subcutaneous tissues and infiltrated the underlying muscle and overlying skin. It had not metastasized. Microscopically it was a spindle cell sarcoma, which resembled the sarcomas induced by the common carcinogens.

At this time 37 of the original 56 mice were living. Some of these quickly developed tumors, so that at

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[1] This work was aided by a grant from the National Advisory Cancer Council.

the end of 16 months, 13 tumors have appeared, and 7 mice are still alive without visible tumors. The number and rate of death with tumors is shown in Table 1.

TABLE 1

Time in months	Living mice	Dead with tumors
0	50	0
5	45	0
6	42	0
7	37	1
8	34	4
9	32	6
10	21	7
11	20	8
12	15	10
13	13	12
14	10	12
15	8	13
16	7	13

These tumors are all spindle or polymorphous cell sarcomas. One has shown metastases to the lungs. They grew rapidly after they first appeared, killing the animals in about three weeks. Much of the injected extract was seen in the subcutaneous tissues. Although it was injected dorsally in the interscapular region part of it gradually migrated to the lateral and even ventral subcutaneous tissues. The sarcomas appeared to arise directly in this orange or brown material, and in two mice multiple, apparently independent, sarcomas were found surrounded by the extract.

Attempts at transplantation were made with three tumors from different mice. Although the recipients were not of a highly inbred stock and the number of animals used was small (five to six) transplantation was successful with two of the three tumors. Serial transplantation was then carried through the fourth transplant generation when it was permitted to die.

Control experiments of several kinds have been made:

Control A. Livers from seven persons who died of a variety of non-neoplastic diseases were extracted in exactly the same way. This nonsaponifiable residue has induced no tumors. The experiment was an exact duplicate of that just described except that the amount injected at one time was only half as large (about 250 mg), but a second injection of the same size was made sixty-five days afterward. Thus the total amount injected was approximately the same, namely 500 mg. The dose was divided in an attempt to reduce sloughing with loss of the extract. Sixty-three mice were originally injected, of which fifty-two are alive and without tumor 220 days after the first injection.

Control B. The non-saponifiable residue from 7,970 gm of carcinoma tissue has failed to induce tumors in experiments identical with those of the livers from cancer patients. In this experiment one injection of .5 gm of extract was made. Thirty-four mice are alive at the end of fourteen months and are without tumor.

Control C. The non-saponifiable residue from 18,435 gms of cancer tissue has failed to produce tumors in mice. These tissues had been fixed by the Kaiserling method before the saponification was made. The cholesterol was also removed from the residue before injections were made. In this experiment an initial injection of 250 mg of the non-saponifiable residue was made into each mouse on December 29, 1939, followed by injections of 100 mg on February 23, 1940, 100 mg on March 25, 1940, and 100 mg on April 22, 1940. Nine months after the first injection thirty mice are living without tumor. The total dose of 550 mg is relatively larger than that used in the other experiments because most of the cholesterol had been removed from this extract.

The results of the control experiments B and C are of interest in view of the experiments recently announced by Menke.[2] By the use of fat solvents he obtained extracts from human mammary gland carcinomas which have induced one tumor in each of two experiments.

Schabad reported the production of tumors by a benzene extract of a liver from a patient with primary carcinoma of the stomach.[3] Heiger has confirmed these results according to Cook,[4] and who gave no details.

A benzene extract of a liver from a case of carcinoma of the stomach has not yielded any tumors in our laboratory, although a total 2.5 cc of the extract was injected in five doses over a period of sixteen weeks. Twenty-six mice lived for six months after the first injection, twenty-one lived for eight months, and nineteen lived for nine months without developing tumors at the site of injection.

It appears then that the non-saponifiable residue of the livers of persons who had cancer, the livers not being involved, contain substances which are cancerogenic for mice. Although sufficient time has not lapsed to permit final conclusions, to date a similar extract from the livers of non-cancer bearing persons has not induced tumors. Similarly, by this method of preparation, cancer tissues themselves did not yield cancerogenic substances.

Experiments are in progress on the chemical separation, on the relation to the type of cancer, on the distribution within the body and on the origin of the substance.

NOTE: The author is indebted to Dr. Carl Marberg, who suggested the method of chemical procedure, and supervised the preliminary chemical work.

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[2] John F. Menke, SCIENCE, 92: 290, 1940.

[3] L. M. Schabad, *Compt. rend. Soc. de Biol.*, 124: 213, 1937.

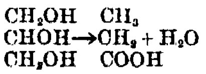
[4] J. W. Cook, E. L. Kennaway and N. M. Kennaway, *Nature*, 145: 627, 1940.

RADIOACTIVE CARBON AS A TRACER IN THE SYNTHESIS OF PROPIONIC ACID FROM CO_2 BY THE PROPIONIC ACID BACTERIA

Recent investigations[1, 2] using radioactive carbon C^{11} and the stable isotope C^{13} on CO_2 uptake by the propionic acid bacteria during the dissimilation of glycerol have demonstrated that the carbon from CO_2 is distributed between the two major products, namely, succinic and propionic acids. The equimolar ratio between CO_2 uptake and succinic acid formation has led to the hypothesis that the succinic acid is formed through the addition of CO_2 to a 3-carbon intermediate, thus yielding the 4-carbon compound.[1, 2, 3] Accordingly, succinic acid should contain labelled carbon (C^*), which was found to be the case;[1] this was confirmed and extended to show that the labelled carbon was present only in the carboxyl groups of the succinic acid.[2] From this evidence it did not appear unreasonable that labelled propionic acid was derived from the succinic acid via decarboxylation.

In a continuation of our earlier studies we have investigated this hypothesis from two aspects, using radioactive C^{11} (half-life of 21 minutes). If propionic acid originates via succinic acid, then labelled succinic acid supplied to the bacteria in the presence of glycerol and inactive bicarbonate should yield labelled propionic acid through loss of one of the carboxyl groups. Furthermore, according to this hypothesis the propionic acid should contain labelled carbon only in the carboxyl group. We have tested this by preparing and separating radioactive propionic and succinic acids using propionic acid bacteria; these labelled acids were re-introduced separately into fresh bacterial suspensions in the presence of inactive CO_2 and glycerol. The fermentation in the presence of the labelled acids was allowed to proceed for 60 to 90 minutes. No convincing evidence for the reaction succinic acid $\rightleftarrows$ propionic acid was found under these conditions.

Decarboxylation of the radioactive propionate to oxalate and carbonate was effected by alkaline $KMnO_4$ oxidation at 100° C. for 30 minutes. The extent of the decarboxylation was followed by two methods, *viz.*, radioactive and gravimetric, with excellent agreement between the two. From 70 to 75 per cent. of the radioactivity was found in the oxalate fraction and 25 to 30 per cent. in the carbonate. The presence of C^* in both the oxalate and carbonate fractions from the oxidation of the propionate suggests the presence of C^* not only in the carboxyl group of the propionic acid but also in the α and/or β positions of the aliphatic chain. It is likely, however, that in the $KMnO_4$ oxidation of the propionate the carbonate liberated is not always the original carboxyl. Thus radioactive oxalate may be obtained from propionate containing C^* only in the carboxyl group. In order to obtain more conclusive evidence for the uniform distribution of the C^* within the propionic acid a dry distillation (at 350° C.) of labelled barium propionate was carried out which yielded labelled barium carbonate and diethyl ketone. If C^* was present only in the carboxyl group then 50 per cent. of the radioactivity would be found in each of the products; if C^* was uniformly distributed then 83.4 per cent. should be in the ketone and 16.6 per cent. in barium carbonate. Experimentally 88 per cent. was found in the ketone and 12 per cent. in the barium carbonate. In addition radioactive CHI_3 was obtained from the $(C_2H_5)_2CO$ by oxidation with I_2 in alkaline solution. In view of these results it seems reasonable to conclude that all the carbons in the propionic acid are labelled, although by the latter method it is not possible to distinguish between the α and β carbons. However, since two thirds of the C^* is found in the oxalate fraction ($KMnO_4$ oxidation), it would appear that all the carbon atoms of propionic acid may originate from CO_2. While it does not necessarily follow that any one molecule of propionic acid is synthesized completely from CO_2, it appears that the net reaction:



$$\begin{array}{ll} CH_2OH & CH_3 \\ CHOH \rightarrow & CH_2 + H_2O \\ CH_2OH & COOH \end{array}$$

proceeds in part through a reduction of carbon dioxide to propionic acid by glycerol. A comparison of the amount of labelled propionic acid with total propionic acid formed by the bacteria during the experiment, as determined by chemical analysis, shows that 5 to 10 per cent. of the total carbon of propionic acid formed originated from C^*O_2. From these experiments a rather unexpected conclusion is reached, namely, the two main products of the glycerol fermentation, propionic and succinic acids are not formed via each other. It seems that an appreciable fraction of the propionic acid has been synthesized from C^*O_2 rather than from a simple transformation of glycerol without degradation of the carbon skeleton. In other words, CO_2 is reduced to propionic acid with an organic compound (in this case glycerol) acting as the ultimate reducing agent. The reduction of CO_2 by all living cells (photosynthetic and non-photosynthetic) for synthesis of cellular constituents or excretory products[4, 5, 6] is strongly supported by the present findings. This reduction of CO_2 may proceed to a greater or lesser extent, depending on the biological system involved, and may require special conditions.

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We have also carried out some experiments on the fermentation of pyruvic acid by the propionic acid bacteria. During this fermentation carried out in the presence of C^*O_2 a relatively large amount of the fixed C^* was found in the form of a carbonyl compound, precipitable as a 2,4 dinitrophenylhydrazone along with pyruvic and oxalacetic acid present as carriers. The possibility of this compound being an α-keto acid with C^* in the carboxyl group is strongly suggested by the enzymatic decarboxylation of the radioactive compound with yeast carboxylase, in which C^*O_2 was obtained. Radioactive propionic and succinic acids were also formed in this fermentation. Details of these and other experiments will be published elsewhere.

We are indebted to Professor C. B. Van Niel and Professor H. A. Barker for much valuable advice and discussion. We wish to thank Professor E. O. Lawrence and members of the Radiation Laboratory for their cooperation.

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MASSIVE "ACUTE" PRECIPITATION OF FREE SULFATHIAZOLE IN THE URINARY TRACT*

The formation of concrements in the urinary tract after chronic administration of sulfanilamide derivatives has been reported repeatedly in the literature.[1, 2, 3] The uroliths were always found to contain a high percentage of the very insoluble *acetylated* form of the different compounds. After administration of sulfapyridine or sulfamethylthiazole the concrements were located mainly in the renal pelves, ureters and bladder, whereas, after sulfathiazole administration, considerable *intrarenal precipitation* (in the collecting tubules) was observed.[4]

In the course of an investigation on the acute intraperitoneal toxicity, in rats and mice, of the 3 derivatives[5] mentioned above, the peculiar observation was made that all animals dying from a single dose of sulfathiazole or its sodium salt, without exception, showed massive precipitation of the *free* drug in the urinary tract. Depending upon the dose, and consequently upon the time-interval between injection and death of the animal, the precipitate was found in different parts of the urinary tract. If death occurred only a few hours after the injection, the collecting tubules and the papillary ducts were filled with a whitish material distinctly visible macroscopically and extending into renal pelves, ureters and bladder. After a longer time-interval, the precipitate in the kidneys diminished in amount and finally disappeared (usually after 24 hours), while the bladder became completely filled and even distended with a white crystalline material, which in some cases reached back into the lower parts of the ureters. Within 10 to 20 hours this soft precipitate in the bladder was converted into hard aggregates weighing between 5 and 30 mg and composed almost entirely of free sulfathiazole. If the animals survived for at least several hours, anatomical signs of irritation were often found in the kidneys (marked enlargement with congestion and edema).

The picture as described in the different stages was seen in 54 rats and 20 mice injected with various doses of sulfathiazole or its sodium salt.

This phenomenon of acute precipitation was further investigated by sacrificing groups of 3 rats at different time-intervals after the intraperitoneal injection of a sublethal dose of sodium sulfathiazole (1.0 g/kg). The urinary tract was examined carefully and drug determinations in blood and various tissues were performed. Some of the results are summarized in Table I.

TABLE I

Determination of Sulfathiazole

Time after injection	Blood		Kidney				Gross precipitation in the renal papilla
	mg. per cent.		mg. per cent. per moist tissue		Total amount in both kidneys in mg.		
	Free	Acetyl	Free	Acetyl	Free	Acetyl	
5 min.	103	0	145	0	2.12	0	0
15 min.	101	0	259	0	4.32	0	±
30 min.	115	0	396	0	6.06	0	++++ massive
60 min.	107	0	322	0	5.06	0	+++
3 hrs.	58	0	266	25	4.96	0.46	++
12 hrs.	44	7	67	27	1.76	0.70	+
24 hrs.	10	5	17	9	0.32	0.18	0

Intraperitoneal injection of sodium sulfathiazole 1.0 g/kg in rats. All figures are the mean of the values from 3 animals.

It can be seen from the table that precipitation (composed entirely of *free* sulfathiazole) reaches its maximum in the renal papilla 30 minutes after the intraperitoneal administration and disappears completely within 24 hours. Acetylation becomes apparent at about 3 hours after the injection. The deposition of relatively increasing amounts of the extremely insoluble acetylated derivative may be responsible for the renal irritation.

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[7] National Research Council Fellow.

* Aided by a grant from the Sidney C. Keller Research Fund.

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The data presented demonstrate the extreme rapidity of absorption and excretion of sulfathiazole and lend further support to the view which has been expressed elsewhere: that the acute precipitation in the urinary tract is due mainly to a high rate of elimination of sulfathiazole from the body. Thus after concentration of the glomerular filtrate by reabsorption of water, precipitation occurs in the collecting tubules.

A similar picture could not be produced with sulfanilamide, sulfapyridine, sulfamethylthiazole or their sodium salts.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MODIFICATION OF RIDDLE'S METHOD OF PROLACTIN ASSAY

While we were comparing the alkaline alcoholic extraction method of Bates and Riddle[1] with the acid acetone extraction method of Lyons[2] for preparing lactogenic hormone of the anterior pituitary, it became necessary to use a large number of pigeons for accurate assaying of various fractions used in the investigations.[3] The purchasing and keeping of the pigeons, however, became so expensive that a way had to be found to reduce the cost as much as possible. The method described below is the result of such an attempt and enables one to assay the hormone without sacrificing the birds. Thus the cost of investigation was greatly reduced.

As in the original method of Riddle, Bates and Dykeshorn,[4] we used both male and female pigeons. On the previous day, before the injection of the sample, the feathers on the pectoral regions of the birds as well as on the area around the crop sac on the neck are carefully plucked. Before the injection of the sample, the skin layer over the crop sac on either right or left side of the median line is incised to the length of about two centimeters, so that the crop sac can be clearly seen. The crop sac is usually colorless and transparent and the presence of food material such as wheat, oats and barley within the sac is clearly discernible. If the crop sac is opaque and thick as in the nesting and nursing period, the pigeon is not suitable for the assay of the hormone and should be exchanged for another bird. Only the pigeons with clear transparent sac are used for the assay. After examination of the sac, the opening is closed by sewing with surgical suture and an appropriate antiseptic, such as tincture of iodine or merthiolate solution, is applied. As in the original method, a definite quantity of the sample solution is injected once daily for four days. On the fifth day (ninety-six hours after the first injection) the crop sac located on the other side of the one previously examined is exposed and examined. According to the condition of the thickening of the sac membrane, the potency of the hormone solution is evaluated.

The method is easy to execute with a little practice. It should be borne in mind, however, that the examination of the sac should be made as soon as it is exposed. The irritating operations such as rubbing of the exposed area with alcohol-soaked cotton swabs or cheesecloth must be avoided, since a slight irritation of the crop sac membrane will result in the thickening of the membrane and may cause an erroneous evaluation of the potency of the sample. It is important to note that during the incising of the skin layer over the sac, great care should be exercised to avoid tearing the crop sac membrane. If, however, the crop sac membrane is cut, the area should be immediately closed by holding together the surrounding membrane and tying with sterile silk thread.

After the examination of the sac, the incised skin layer is closed by sewing with surgical suture and an antiseptic is applied. The pigeon is then kept in a large cage for three to four weeks or until the incised area is perfectly healed. They are then ready to be used again for prolactin assay.

The authors are aware of the fact that an accurate assaying of the hormone by this method or any other biological method is a difficult task. This is due to the variation in the sensitivity of the individual birds, even among the same strain.[1, 2] The difficulty can be overcome if a large number of birds are used for the assay of a sample and also by using a standard preparation for comparison as recommended by Bates and Riddle or by the Commission on Biological Standardization of the League of Nations. The authors believe that by the use of the method described here and with the use of a standard preparation, a great deal of saving will be accomplished without sacrificing the accuracy of the assay.

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CELLOPHANE COVER SLIPS AND A METHOD FOR MOUNTING

Because the price and paucity of cover glasses used in the preparation of microscope slides have become almost prohibitive of their use, an efficient, economical substitute has been sought. O'Brien and Hance[1] have stated that isobutyl methacrylate may be used to replace the cover. This has not been found practical when slides are produced in large numbers. The solution seems also to detract from the brilliancy of the stain. Suntzeff and Smith[2] recommend a plastic, cellulose acetate, obtained in sheets the approximate thickness of No. 1 cover glasses. They experience some difficulty in its use because the plastic tends to curl unless the slides are carefully dried at room temperature for five to six days.

Plain transparent Cellophane[3] has been used in our laboratory during the past seven months. Cellophane covers have a refractive index of 1.53, dry rapidly and without curling, are very thin and inexpensive. Cellophane can be obtained in rolls 15/16ths inch wide, slightly less than the width of a slide. Strips of the desired length are cut as needed. No. 300 plain Cellophane seems to be most satisfactory. It is .00088 inch (0.022 mm) thick. (No. 1 cover slips average 0.13 mm in thickness.) It is possible to take photomicrographs from slides having Cellophane covers. Oil immersion does not affect Cellophane but for high magnifications replacements with glass covers may prove desirable.

The only difficulty so far encountered in the use of Cellophane as a substitute for glass cover slips has been the storage of the roll. During the winter months it can be kept at ordinary room temperatures, but under more humid conditions the Cellophane absorbs moisture, the edges of the roll wrinkle and will not lie smoothly. This wrinkling can be avoided by storing the roll of Cellophane in a desiccator, but continued storage over a long period causes warping and cracking.

Moistureproof Cellophane is less susceptible to atmospheric changes, but it too will wrinkle, and does not seem to be quite as clear as the plain. Cellulose acetate[4] No. 88 was tried, but was found not to adhere to the slide when dry. This is probably caused by the xylol used to mount the covers.

A method long used for mounting glass covers is successful with Cellophane as well. Instead of leaving the slides to dry in trays they are turned face down on clean paper towels and xylol is pipetted between them. An extra towel on top readily absorbs any excess on the back of the slide. In 15–30 minutes the slides are ready for use. This method has several advantages: (1) it insures a thin layer of mounting medium under the cover, (2) the slides are ready for immediate use. Further drying in an oven is entirely unnecessary, (3) it removes any excess mounting medium, leaving the edges and ends of the slide clean and dry. Canada balsam was first used in this manner but since the appearance of an article by Groat[5] we have used Clarite exclusively. It dries more rapidly than balsam, is clear and adheres well to Cellophane.

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[1] O'Brien and Hance, Science, 91: 412, 1940.

[2] Suntzeff and Smith, Science, 92: 17–18, 1940.

[3] A du Pont product obtained through H. D. Catty Distributing Company, 3311 Carroll Avenue, Chicago, Illinois.

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THE MATHEMATICAL WAY OF THINKING[1]

By Dr. HERMANN WEYL

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BY the mathematical way of thinking I mean first that form of reasoning through which mathematics penetrates into the sciences of the external world—physics, chemistry, biology, economics, etc., and even into our everyday thoughts about human affairs, and secondly that form of reasoning which the mathematician, left to himself, applies in his own field. By the mental process of thinking we try to ascertain truth; it is our mind's effort to bring about its own enlightenment by evidence. Hence, just as truth itself and the experience of evidence, it is something fairly uniform and universal in character. Appealing to the light in our innermost self, it is neither reducible to a set of mechanically applicable rules, nor is it divided into watertight compartments like historic, philosophical, mathematical thinking, etc. We mathematicians are no Ku Klux Klan with a secret ritual of thinking. True, nearer the surface there are certain techniques and differences; for instance, the procedures of fact-finding in a courtroom and in a physical laboratory are conspicuously different. However, you should not expect me to describe the mathematical way of thinking much more clearly than one can describe, say, the democratic way of life.

A movement for the reform of the teaching of mathematics, which some decades ago made quite a stir in Germany under the leadership of the great mathematician Felix Klein, adopted the slogan "functional thinking." The important thing which the average educated man should have learned in his mathematics classes, so the reformers claimed, is thinking in terms of *variables and functions.* A function describes how one variable y depends on another x; or more generally, it maps one variety, the range of a variable element x, upon another (or the same) variety. This idea of function or mapping is certainly one of the most fundamental concepts, which accompanies mathematics at every step in theory and application.

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[1] Address delivered at the Bicentennial Celebration Conference of the University of Pennsylvania, September 17, 1940.

Our federal income tax law defines the tax y to be paid in terms of the income x; it does so in a clumsy enough way by pasting several linear functions together, each valid in another interval or bracket of income. An archeologist who, five thousand years from now, shall unearth some of our income tax returns together with relics of engineering works and mathematical books, will probably date them a couple of centuries earlier, certainly before Galileo and Vieta. Vieta was instrumental in introducing a consistent algebraic symbolism; Galileo discovered the quadratic law of falling bodies, according to which the drop s of a body falling in a vacuum is a quadratic function of the time t elapsed since its release:

$$s = \tfrac{1}{2}gt^2, \qquad (1)$$

g being a constant which has the same value for each body at a given place. By this formula Galileo converted a natural law inherent in the actual motion of bodies into an *a priori* constructed mathematical function, and that is what physics endeavors to accomplish for every phenomenon. The law is of much better design than our tax laws. It has been designed by Nature, who seems to lay her plans with a fine sense for mathematical simplicity and harmony. But then Nature is not, as our income and excess profits tax laws are, hemmed in by having to be comprehensible to our legislators and chambers of commerce.

Right from the beginning we encounter these characteristic features of the mathematical process: 1) variables, like t and s in the formula (1), whose possible values belong to a range, here the range of real numbers, which we can completely survey because it springs from our own free construction, 2) representation of these variables by symbols, and 3) functions or *a priori* constructed mappings of the range of one variable t upon the range of another s. *Time* is the independent variable *kat exochen.*

In studying a function one should let the independent variable run over its full range. A conjecture about the mutual interdependence of quantities in nature, even before it is checked by experience, may be probed in thought by examining whether it carries through over the whole range of the independent variables. Sometimes certain simple *limiting cases* at once reveal that the conjecture is untenable. Leibnitz taught us by his *principle of continuity* to consider rest not as contradictorily opposed to motion, but as a limiting case of motion. Arguing by continuity he was able *a priori* to refute the laws of impact proposed by Descartes. Ernst Mach gives this prescription: "After having reached an opinion for a special case, one gradually modifies the circumstances of this case as far as possible, and in so doing tries to stick to the original opinion as closely as one can. There is no procedure which leads more safely and with greater mental economy to the simplest interpretation of all natural events." Most of the variables with which we deal in the analysis of nature are continuous variables like time, but although the word seems to suggest it, the mathematical concept is not restricted to this case. The most important example of a discrete variable is given by the sequence of natural numbers or integers 1, 2, 3, . . . Thus the number of divisors of an arbitrary integer n is a function of n.

In Aristotle's logic one passes from the individual to the general by exhibiting certain abstract features in a given object and discarding the remainder, so that two objects fall under the same concept or belong to the same genus if they have those features in common. This descriptive classification, *e.g.*, the description of plants and animals in botany and zoology, is concerned with the actual existing objects. One might say that Aristotle thinks in terms of substance and accident, while the functional idea reigns over the formation of mathematical concepts. Take the notion of ellipse. Any ellipse in the x-y-plane is a set E of points (x, y) defined by a quadratic equation

$$ax^2 + 2bxy + cy^2 = 1$$

whose coefficients a, b, c satisfy the conditions

$$a > 0, \quad c > 0, \quad ac - b^2 > 0.$$

The set E depends on the coefficients a, b, c; we have a function $E(a, b, c)$ which gives rise to an individual ellipse by assigning definite values to the variable coefficients a, b, c. In passing from the individual ellipse to the general notion one does not discard any specific difference, one rather makes certain characteristics (here represented by the coefficients) variable over an *a priori* surveyable range (here described by the inequalities). The notion thus extends over all *possible*, rather than over all *actually existing*, specifications.[1]

From these preliminary remarks about functional thinking I now turn to a more systematic argument. Mathematics is notorious for the thin air of abstraction in which it moves. This bad reputation is only half deserved. Indeed, the first difficulty the man in the street encounters when he is taught to think mathematically is that he must learn to look things much more squarely in the face; his belief in words must be shattered; he must learn to think more concretely.

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[1] Compare about this contrast Ernst Cassirer, ''Substanzbegriff und Funktionsbegriff,'' 1910, and my critical remark, ''Philosophie der Mathematik und Naturwissenschaft,'' 1923, p. 111.

Only then will he be able to carry out the second step, the step of abstraction where intuitive ideas are replaced by purely symbolic construction.

About a month ago I hiked around Longs Peak in the Rocky Mountain National Park with a boy of twelve, Pete. Looking up at Longs Peak he told me that they had corrected its elevation and that it is now 14,255 feet instead of 14,254 feet last year. I stopped a moment asking myself what this could mean to the boy, and should I try to enlighten him by some Socratic questioning. But I spared Pete the torture, and the comment then withheld, will now be served to you. Elevation is elevation above sea level. But there is no sea under Longs Peak. Well, in idea one continues the actual sea level under the solid continents. But how does one construct this ideal closed surface, the geoid, which coincides with the surface of the oceans over part of the globe? If the surface of the ocean were strictly spherical, the answer would be clear. However, nothing of this sort is the case. At this point dynamics comes to our rescue. Dynamically the sea level is a surface of constant potential $\Phi = \Phi_0$; more exactly Φ denotes the gravitational potential of the earth, and hence the difference of Φ at two points P, P' is the work one must put into a small body of mass 1 to transfer it from P to P'. Thus it is most reasonable to define the geoid by the dynamical equation $\Phi = \Phi_0$. If this constant value of Φ fixes the elevation zero, it is only natural to define any fixed altitude by a corresponding constant value of Φ, so that a peak P is called higher than P' if one gains energy by flying from P to P'. The geometric concept of altitude is replaced by the dynamic concept of potentional or energy. Even for Pete, the mountain climber, this aspect is perhaps the most important: the higher the peak the greater—*ceteris paribus*—the mechanical effort in climbing it. By closer scrutiny one finds that in almost every respect the potential is the relevant factor. For instance the barometric measurement of altitude is based on the fact that in an atmosphere of given constant temperature the potential is proportional to the logarithm of the atmospheric pressure, whatever the nature of the gravitational field. Thus atmospheric pressure, generally speaking, indicates potential and not altitude. Nobody who has learned that the earth is round and the vertical direction is not an intrinsic geometric property of space but the direction of gravity should be surprised that he is forced to discard the geometric idea of altitude in favor of the dynamic more concrete idea of potential. Of course there is a relationship to geometry: In a region of space so small that one can consider the force of gravity as constant throughout this region, we have a fixed vertical direction, and potential differences are proportional to differences of altitude measured in that direction. Altitude, height, is a word which has a clear meaning when I ask how high the ceiling of this room is above its floor. The meaning gradually loses precision when we apply it to the relative altitudes of mountains in a wider and wider region. It dangles in the air when we extend it to the whole globe, unless we support it by the dynamical concept of potential. Potential is more concrete than altitude because it is generated by and dependent on the mass distribution of the earth.

Words are dangerous tools. Created for our everyday life they may have their good meanings under familiar limited circumstances, but Pete and the man in the street are inclined to extend them to wider spheres without bothering about whether they then still have a sure foothold in reality. We are witnesses of the disastrous effects of this witchcraft of words in the political sphere where all words have a much vaguer meaning and human passion so often drowns the voice of reason. The scientist must thrust through the fog of abstract words to reach the concrete rock of reality. It seems to me that the science of economics has a particularly hard job, and will still have to spend much effort, to live up to this principle. It is, or should be, common to all sciences, but physicists and mathematicians have been forced to apply it to the most fundamental concepts where the dogmatic resistance is strongest, and thus it has become their second nature. For instance, the first step in explaining relativity theory must always consist in shattering the dogmatic belief in the temporal terms past, present, future. You can not apply mathematics as long as words still becloud reality.

I return to relativity as an illustration of this first important step preparatory to mathematical analysis, the step guided by the maxim, "Think concretely." As the root of the words *past, present, future,* referring to time, we find something much more tangible than time, namely, the causal structure of the universe. Events are localized in space and time; an event of small extension takes place at a space-time or world point, a here-now. After restricting ourselves to events on a plane E we can depict the events by a graphic timetable in a three-dimensional diagram with a horizontal E plane and a vertical t axis on which time t is plotted. A world point is represented by a point in this picture, the motion of a small body by a world line, the propagation of light with its velocity c radiating from a light signal at the world point O by a vertical straight circular cone with vertex at O (light cone). The *active future* of a given world point O, here-now, contains all those events which can still be influenced by what happens at O, while its *passive past* consists of all those world points from which any influence, any message, can reach O. I here-now can no longer change anything that lies outside the active future; all events of which I here-now can have knowledge by direct observation or any records thereof necessarily lie in the passive past. We interpret the words past and future in this causal sense where they express something very real and important, the causal structure of the world.

The new discovery at the basis of the theory of relativity is the fact that no effect may travel faster than light. Hence while we formerly believed that active future and passive past bordered on each other along the cross-section of *present,* the horizontal plane $t =$ const. going through O, Einstein taught us that the active future is bounded by the forward light cone and the passive past by its backward continuation. Active future and passive past are separated by the part of the world lying between these cones, and with this part I am here-now not at all causally connected. The essential positive content of relativity theory is this new insight into the causal structure of the universe. By discussing the various interpretations of such a simple question as whether two men, say Bill on earth and Bob on Sirius, are contemporaries, as to whether it means that Bill can send a message to Bob, or Bob a message to Bill, or even that Bill can communicate with Bob by sending a message and receiving an answer, etc., I often succeed soon in accustoming my listener to thinking in terms of causal rather than his wonted temporal structure. But when I tell him that the causal structure is not a stratification by horizontal layers $t =$ const., but that active future and passive past are of cone-like shape with an interstice between, then some will discern dimly what I am driving at, but every honest listener will say: Now you draw a figure, you speak in pictures; how far does the simile go, and what is the naked truth to be conveyed by it? Our popular writers and news reporters, when they have to deal with physics, indulge in similes of all sorts; the trouble is that they leave the reader helpless in finding out how far these pungent analogies cover the real issue, and therefore more often lead him astray than enlighten him. In our case one has to admit that our diagram is no more than a picture, from which, however, the real thing emerges as soon as we replace the intuitive space in which our diagrams are drawn by its construction in terms of sheer symbols. Then the phrase that the world is a four-dimensional continuum changes from a figurative form of speech into a statement of what is literally true. At this second step the mathematician turns abstract, and here is the point where the layman's understanding most frequently breaks off: the intuitive picture must be exchanged for a symbolic construction. "By its geometric and later by its purely symbolic construction," says Andreas Speiser, "mathematics shook off the fetters of language, and one who knows the enormous work put into this process and its ever recurrent surprising successes can not help feeling that mathematics to-day is more efficient in its sphere of the intellectual world, than the modern languages in their deplorable state or even music are on their respective fronts." I shall spend most of my time to-day in an attempt to give you an idea of what this magic of symbolic construction is.

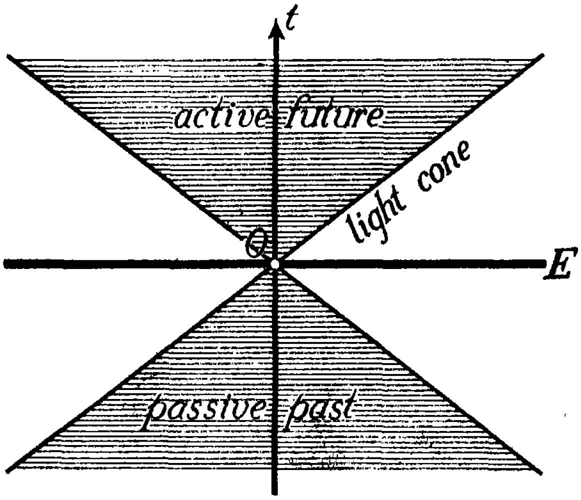

FIG. 1

To that end I must begin with the simplest, and in a certain sense most profound, example: the natural numbers or *integers* by which we *count* objects. The symbols we use here are strokes put one after another. The objects may disperse, "melt, thaw and resolve themselves into a dew," but we keep this record of their number. What is more, we can by a constructive process decide for two numbers represented through such symbols which one is the larger, namely by checking one against the other, stroke by stroke. This process reveals differences not manifest in direct observation, which in most instances is incapable of distinguishing between even such low numbers as 21 and 22. We are so familiar with these miracles which the number symbols perform that we no longer wonder at them. But this is only the prelude to the mathematical step proper. We do not leave it to chance which numbers we shall meet by counting actual objects, but we generate the open sequence of *all possible* numbers which starts with 1 (or 0) and proceeds by adding to any number symbol n already reached one more stroke, whereby it changes into the following number n'. As I have often said before, being is thus projected onto the background of the possible, or more precisely onto a manifold of possibilities which unfolds by iteration and is open into infinity. Whatever number n we are given, we always deem it possible to pass to the next n'. "Number goes on." This intuition of the "ever one more," of the open countable infinity, is basic for all mathematics. It gives birth to the simplest example of what I termed above an *a priori* surveyable range of variability. According to this process by which the integers are created, functions of an argument ranging over all integers n are to be defined by so-called complete induction, and statements holding for all n are to be proved in the same fashion. The principle of this inference by complete induction is as follows. In order to show that every number n has a certain property V it is sufficient to make sure of two things:

1) 0 has this property;
2) If n is any number which has the property V, then the next number n' has the property V.

It is practically impossible, and would be useless, to write out in strokes the symbol of the number 10^{12}, which the Europeans call a billion and we in this country, a thousand billions. Nevertheless we talk about spending more than 10^{12} cents for our defense program, and the astronomers are still ahead of the financiers. In July the *New Yorker* carried this cartoon: man and wife reading the newspaper over their breakfast and she looking up in puzzled despair: "Andrew, how much *is* seven hundred billion dollars?" A profound and serious question, lady! I wish to point out that only by passing through the *infinite* can we attribute any significance to such figures. 12 is an abbreviation of

$$10^{12} = \overset{/\quad/\quad/\quad/\quad/\quad/\quad/\quad/\quad/\quad/\quad/\quad/.}{\overline{10\cdot10\cdot10\cdot10\cdot10\cdot10\cdot10\cdot10\cdot10\cdot10\cdot10\cdot10}}$$

can not be understood without defining the function $10\cdot n$ for *all* n, and this is done through the following definition by complete induction:

$$10\cdot 0 = 0,$$
$$10\cdot n' = (10\cdot n)^{\prime\prime\prime\prime\prime\prime\prime\prime\prime\prime}.$$

The dashes constitute the explicit symbol for 10, and, as previously, each dash indicates transition to the next *number*. *Indian, in particular Buddhist*, literature indulges in the possibilities of fixing stupendous numbers by the decimal system of numeration which the Indians invented, *i.e.*, by a combination of sums, products and powers. I mention also Archimedes's treatise "On the counting of sand," and Professor Kasner's Googolplex in his recent popular book on "Mathematics and the Imagination."

Our conception of *space* is, in a fashion similar to that of natural numbers, depending on a constructive grip on all *possible* places. Let us consider a metallic disk in a plane E. Places on the disk can be marked *in concreto* by scratching little crosses on the plate. But relatively to two axes of coordinates and a standard length scratched into the plate we can also put ideal marks in the plane outside the disk by giving the numerical values of their two coordinates. Each coordinate varies over the *a priori* constructed range of real numbers. In this way astronomy uses our solid earth as a base for plumbing the sidereal spaces. What a marvelous feat of imagination when the Greeks first constructed the shadows which earth and moon, illumined by the sun, cast in empty space and thus explained the eclipses of sun and moon! In analyzing a continuum, like space, we shall here proceed in a somewhat more general manner than by measurement of coordinates and adopt the *topological* viewpoint, so that two continua arising one from the other by continuous deformation are the same to us. Thus the following exposition is at the same time a brief introduction to an important branch of mathematics, topology.

The symbols for the localization of points on the one-dimensional continuum of a straight line are the *real numbers*. I prefer to consider a *closed* one-dimensional continuum, the circle. The most fundamental statement about a continuum is that it may be divided into parts. We catch all the points of a continuum by spanning a net of division over it, which we refine by repetition of a definite process of subdivision *ad infinitum*. Let S be any division of the circle into a number of arcs, say l arcs. From S we derive a new division S' by the process of *normal subdivision*, which consists in breaking each arc into two. The number of arcs in S' will then be $2l$. Running around the circle in a definite sense (orientation) we may distinguish the two pieces, in the order in which we meet them, by the marks 0 and 1; more explicitly, if the arc is denoted by a symbol α then these two pieces are designated as $\alpha 0$ and $\alpha 1$. We start with the division S_0 of the circle into two arcs + and −; either is topologically a cell, *i.e.*, equivalent to a segment. We then iterate the process of normal subdivision and thus obtain S_0', S_0'', $\cdots$, seeing to it that the refinement of the division ultimately pulverizes the whole circle. If we had not renounced the use of metric properties we could decree that the normal subdivision takes place by cutting each arc into two *equal* halves. We introduce no such fixation; hence the actual performance of the process involves a wide measure of arbitrariness. However, the *combinatorial scheme* according to which the parts reached at any step border on each other, and according to which the division progresses, is unique and perfectly fixed. Mathematics cares for this symbolic scheme only. By our notation the parts occurring at the consecutive divisions are *catalogued* by symbols of this type

$$+.011010001$$

with + or − before the dot and all following places occupied by either 0 or 1. We see that we arrive at the familiar symbols of binary (not decimal) fractions. A point is caught by an infinite sequence of arcs of the consecutive divisions such that each arc arises from the preceding one by choosing one of the two pieces into which it breaks by the next normal subdivision, and the point is thus fixed by an infinite binary fraction.

Let us try to do something similar for two-dimensional continua, *e.g.*, for the surface of a sphere or a torus. The figures show how we may cast a very coarse net over either of them, the one consisting of two, the other of four meshes; the globe is divided into its upper and lower halves by the equator, the torus is welded together from four rectangular plates. The meshes are two-dimensional cells, or briefly, 2-cells which are topologically equivalent to a circular disk. The combinatorial description is facilitated by introducing also the vertices and edges of the division, which are 0- and 1-cells. We attach arbitrary symbols to them and state in symbols for each 2-cell which 1-cells bound it, and for each 1-cell by which 0-cells it is bounded. We then arrive at a *topological scheme* S_0. Here are our two examples:

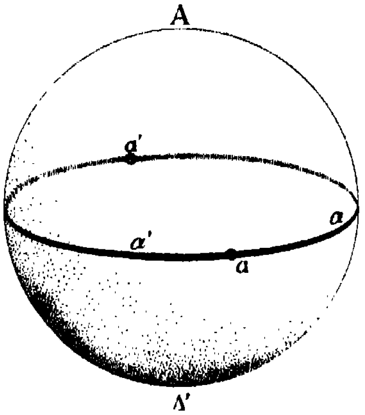

FIG. 2

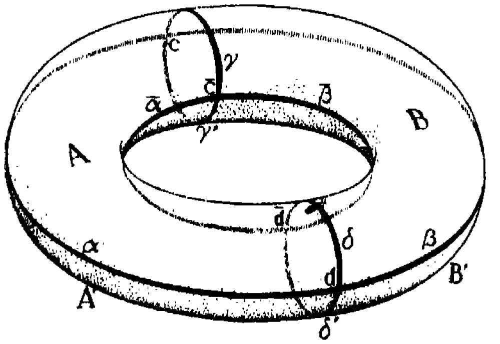

FIG. 3

Sphere. $A \rightarrow \alpha, \alpha'$. $A' \rightarrow \alpha, \alpha'$. $\alpha \rightarrow a, a'$. $\alpha' \rightarrow a, a'$.
($\rightarrow$ means: bound by)

Torus. $A \rightarrow \alpha, \bar{\alpha}, \gamma, \delta$. $A' \rightarrow \alpha, \bar{\alpha}, \gamma', \delta'$.
$B \rightarrow \beta, \bar{\beta}, \gamma, \delta$. $B' \rightarrow \beta, \bar{\beta}, \gamma', \delta'$.
$\alpha \rightarrow c, d$. $\bar{\alpha} \rightarrow \bar{c}, \bar{d}$. $\beta \rightarrow c, d$. $\bar{\beta} \rightarrow \bar{c}, \bar{d}$.
$\gamma \rightarrow c, \bar{c}$. $\gamma' \rightarrow c, \bar{c}$. $\delta \rightarrow d, \bar{d}$. $\delta' \rightarrow d, \bar{d}$.

From this initial stage we proceed by iteration of a universal process of normal subdivision: On each 1-cell $\alpha = ab$ we choose a point which serves as a new vertex α and divides the 1-cell into two segments $a\alpha$ and αb; in each 2-cell A we choose a point A and cut the cell into triangles by joining the newly created vertex A with the old and new vertices on its bounding 1-cells by lines within the 2-cell. Just as in elementary geometry we denote the triangles and their sides by means of their vertices. The figure shows a pentagon before and after subdivision; the triangle $A\beta c$ is bounded by the 1-cells βc, $A\beta$, Ac, the 1-cell Ac for instance by the vertices c and A. We arrive at the following general purely symbolic description of the process by which the subdivided scheme S' is derived from a given topological scheme S. Any symbol $e_2\ e_1\ e_0$ made up by the symbols of a 2-cell e_2, a 1-cell e_1 and a 0-cell e_0 in S such that e_2 is bounded by e_1 and e_1 bounded by e_0 represents a 2-cell e'_2 of S'. This 2-cell $e'_2 = e_2e_1e_0$ in S' is part of the 2-cell e_2 in S. The symbols of cells in S' which bound a given cell are derived from its symbol by dropping any one of its constituent letters. Through iteration of this symbolic process the initial scheme S_0 gives rise to a sequence of derived schemes S_0', S_0'', S_0''', · · ·. What we have done is nothing else than devise a systematic cataloguing of the parts created by consecutive subdivisions. A *point* of our continuum is caught by a sequence

$$e\ e'\ e''\ \cdots \qquad (2)$$

which starts with a 2-cell e of S_0 and in which the 2-cell $e^{(n)}$ of the scheme $S^{(n)}$ is followed by one of the 2-cells $e^{(n+1)}$ of $S^{(n+1)}$ into which $e^{(n)}$ breaks up by our subdivision. (To do full justice to the inseparability of parts in a continuum this description ought to be slightly altered. But for the present purposes our simplified description will do.) We are convinced that not only may each point be caught by such a sequence (Eudoxos), but that an arbitrarily constructed sequence of this sort always catches a point (Dedekind, Cantor). The fundamental concepts of *limit, convergence* and *continuity* follow in the wake of this construction.

We now come to the decisive step of mathematical abstraction: we forget about what the symbols stand for. The mathematician is concerned with the catalogue alone; he is like the man in the catalogue room who does not care what books or pieces of an intuitively given manifold the symbols of his catalogue denote. He need not be idle; there are many operations which he may carry out with these symbols, without ever having to look at the things they stand for. Thus, replacing the points by their symbols (2) he turns the given manifold into a *symbolic construct* which we shall call the *topological space* $\{S_0\}$ because it is based on the scheme S_0 alone.

The details are not important; what matters is that once the initial finite symbolic scheme S_0 is given we are carried along by an absolutely rigid symbolic construction which leads from S_0 to S_0', from S_0' to S_0'', etc. The idea of iteration, first encountered with the natural numbers, again plays a decisive role. The realization of the symbolic scheme for a given manifold, say a sphere or a torus, as a scheme of consecutive divisions involves a wide margin of arbitrariness restricted only by the requirement that the pattern of the meshes ultimately becomes infinitely fine everywhere. About this point and the closely affiliated requirement that each 2-cell has the topological structure of a circular disk, I must remain a bit vague. However, the mathematician is not concerned with applying the scheme or catalogue to a given manifold, but only with the scheme itself, which contains no haziness whatsoever. And we shall presently see that even the physicist need not care greatly about that application. It was merely for heuristic purposes that we had to go the way from manifold through division to pure symbolism.

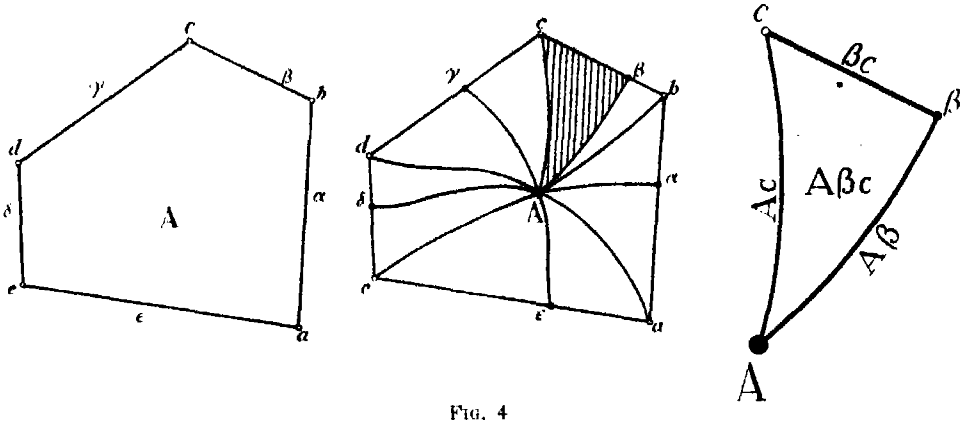

FIG. 4

In the same purely symbolic way we can evidently construct not only 1- and 2- but also 3, 4, 5, . . . -dimensional manifolds. An n-dimensional scheme S_0 consists of symbols distinguished as 0, 1, 2, . . . , n-cells and associates with each i-cell e_i $(i=1, 2, \cdots, n)$ certain $(i-1)$-cells of which one says that they bound e_i. It is clear how the process of normal subdivision carries over. *A certain such 4-dimensional scheme can be used for the localization of events,* of all possible here-nows; physical quantities which vary in space and time are functions of a variable point ranging over the corresponding symbolically constructed 4-dimensional topological space. In this sense the world *is* a 4-dimensional continuum. The causal structure, of which we talked before, will have to be constructed within the medium of this 4-dimensional world, *i.e.*, out of the symbolic material constituting our topological space. Incidentally the topological viewpoint has been adopted on purpose, because only thus our frame becomes wide enough to embrace both special and general relativity theory. The special theory envisages the causal structure as something geometrical, rigid, given once for all, while in the general theory it becomes flexible and dependent on matter in the same way as, for instance, the electromagnetic field.

In our analysis of nature we reduce the phenomena to simple elements each of which varies over a certain range of possibilities which we can survey *a priori* because we construct these possibilities *a priori* in a purely combinatorial fashion from some purely symbolic material. The manifold of space-time points is one, perhaps the most basic one, of these constructive elements of nature. We dissolve light into plane polarized monochromatic light beams with few variable characteristics like wave length which varies over the symbolically constructed continuum of real numbers. Because of this *a priori* construction we speak of a *quantitative* analysis of nature; I believe the word quantitative, if one can give it a meaning at all, ought to be interpreted in this wide sense. The power of science, as witnessed by the development of modern technology, rests upon the combination of *a priori* symbolic construction with systematic experience in the form of planned and reproducible reactions and their measurements. As material for the *a priori* construction, Galileo and Newton used certain features of reality like space and time which they considered as objective, in opposition to the subjective sense qualities, which they discarded. Hence the important role which geometric figures played in their physics. You probably know Galileo's words in the *Saggiatore* where he says that no one can read the great book of nature "unless he has mastered the code in which it is composed, that is, the mathematical figures and the necessary relations between them." Later we have learned that none of these features of our immediate observation, not even space and time, have a right to survive in a pretended truly objective world, and thus have gradually and ultimately come to adopt a purely symbolic combinatorial construction.

While a set of objects determines its number unambiguously, we have observed that a scheme of division S_0 with its consecutive derivatives S_0', S_0'', $\cdots$ can be established on a given manifold in many ways involving a wide margin of arbitrariness. But the question whether two schemes,

$$S_0, S_0', S_0'' \cdots \text{ and } T_0, T_0', T_0'' \cdots$$

are fit to describe the same manifold is decidable in a purely mathematical way: it is necessary and sufficient that the two topological spaces $\{S_0\}$ and $\{T_0\}$ can be mapped one upon the other by a continuous one-to-one transformation—a condition which ultimately boils down to a certain relationship called isomorphism between the two schemes S_0 and T_0. (Incidentally the problem of establishing the criterion of isomorphism for two finite schemes in finite combinatorial form is one of the outstanding unsolved mathematical problems.) The connection between a given continuum and its symbolic scheme inevitably carries with it this notion of *isomorphism;* without it and without our understanding that isomorphic schemes are to be considered as not intrinsically different, no more than congruent figures in geometry, the mathematical concept of a topological space would be incomplete. Moreover it will be necessary to formulate precisely the conditions which every topological scheme is required to satisfy. For instance, one such condition demands that each 1-cell be bounded by exactly *two* 0-cells.

I can now say a little more clearly why the physicist is almost as disinterested as the mathematician in the particular way how a certain combinatorial scheme of consecutive divisions is applied to the continuum of here-nows which we called the world. Of course, somehow our theoretical constructions must be put in contact with the observable facts. The historic development of our theories proceeds by heuristic arguments over a long and devious road and in many steps from experience to construction. But systematic exposition should go the other way: first develop the theoretical scheme without attempting to define individually by appropriate measurements the symbols occurring in it as space-time coordinates, electromagnetic field strengths, etc., then describe, as it were in one breath, the contact of the whole system with observable facts. The simplest example I can find is the observed angle between two stars. The symbolic construct in the medium of the 4-dimensional world from which theory determines and predicts the value of this angle includes: (1) the world-lines of the two stars, (2) the causal structure of the universe, (3) the world position of the observer and the direction of his world line at the moment of observation. But a continuous deformation, a one-to-one continuous transformation of this whole picture, does not affect the value of the angle. *Isomorphic pictures lead to the same results concerning observable facts.* This is, in its most general form, the *principle of relativity.* The arbitrariness involved in our ascent from the given manifold to the construct is expressed by this principle for the opposite descending procedure, which the systematic exposition should follow.

So far we have endeavored to describe how a mathematical construct is distilled from the given raw material of reality. Let us now look upon these products of distillation with the eye of a pure mathematician. One of them is the sequence of natural numbers and the other the general notion of a topological space $\{S_0\}$ into which a topological scheme S_0 develops by consecutive derivations S_0, S_0', S_0'', $\cdots$. In both cases *iteration* is the most decisive feature. Hence all our reasoning must be based on evidence concerning that completely transparent process which generates the natural numbers, rather than on any principles of formal logic like syllogism, etc. The business of the constructive mathematician is *not* to draw logical conclusions. Indeed his arguments and propositions are merely an accompaniment of his actions, his carrying out of constructions. For instance, we run over the sequence of integers 0, 1, 2, . . . by saying alternatingly even, odd, even, odd, etc., and in view of the possibility of this inductive construction which we can extend as far as we ever wish, we formulate the general arithmetical proposition: "Every integer is even or odd." Besides the idea of iteration (or the sequence of integers) we make constant use of mappings or of the functional idea. For instance, just now we have defined a function $\pi(n)$, called parity, with n ranging over all integers and π capable of the two values 0 (even) and 1 (odd), by this induction:

$$\pi(0) = 0;$$
$$\pi(n') = 1 \text{ if } \pi(n) = 0, \qquad \pi(n') = 0 \text{ if } \pi(n) = 1.$$

Structures such as the topological schemes are to be studied in the light of the idea of *isomorphism.* For instance, when it comes to introducing operators τ which carry any topological scheme S into a topological scheme $\tau(S)$ one should pay attention only to such operators or functions τ for which isomorphism of S and R entails isomorphism for $\tau(S)$ and $\tau(R)$.

Up to now I have emphasized the constructive character of mathematics. In our actual mathematics there vies with it the non-constructive *axiomatic method.* Euclid's axioms of geometry are the classical prototype. Archimedes employs the method with great acumen and so do later Galileo and Huyghens in erecting the science of mechanics. One defines all concepts in terms of a few undefined basic concepts and deduces all propositions from a number of basic propositions, the axioms, concerning the basic concepts. In earlier times authors were inclined to claim *a priori* evidence for their axioms; however this is an epistemological aspect which does not interest the mathematician. Deduction takes place according to the principles of formal logic, in particular it follows the syllogistic scheme. Such a treatment *more geometrico* was for a long time considered the ideal of every science. Spinoza tried to apply it to ethics. For the mathematician the meaning of the words representing the basic concepts is irrelevant; any interpretation of them which fits, *i.e.*, under which the axioms become true, will be good, and all the propositions of the discipline will hold for such an interpretation because they are all logical consequences of the axioms. Thus n-dimensional Euclidean geometry permits another interpretation where points are distributions of electric current in a given circuit consisting of n branches which connect at certain branch points. For instance, the problem of determining that distribution which results from given electromotoric forces inserted in the various branches of the net corresponds to the geometric construction of orthogonal projection of a point upon a linear subspace. From this standpoint mathematics treats of relations in a hypothetical-deductive manner without binding itself to any particular material interpretation. It is not concerned with the *truth* of axioms, but only with their *consistency;* indeed inconsistency would *a priori* preclude the possibility of our ever coming across a fitting interpretation. "Mathematics is the science which draws necessary conclusions," says B. Peirce in 1870, a definition which was in vogue for decades after. To me it seems that it renders very scanty information about the real nature of mathematics, and you are at present watching my struggle to give a fuller characterization. Past writers on the philosophy of mathematics have so persistently discussed the axiomatic method that I don't think it necessary for me to dwell on it at any greater length, although my exposition thereby becomes somewhat lopsided.

However I should like to point out that since the axiomatic attitude has ceased to be the pet subject of the methodologists its influence has spread from the roots to all branches of the mathematical tree. We have seen before that topology is to be based on a full enumeration of the axioms which a *topological scheme* has to satisfy. One of the simplest and most basic axiomatic concepts which penetrates all fields of mathematics is that of *group*. Algebra with its *"fields," "rings,"* etc., is to-day from bottom to top permeated by the axiomatic spirit. Our portrait of mathematics would look a lot less hazy, if time permitted me to explain these mighty words which I have just uttered, group, field and ring. I shall not try it, as little as I have stated the axioms characteristic for a topological scheme. But such notions and their kin have brought it about that modern mathematical research often is a dexterous blending of the constructive and the axiomatic procedures. Perhaps one should be content to note their mutual interlocking. But temptation is great to adopt one of these two views as the genuine primordial way of mathematical thinking, to which the other merely plays a subservient role, and it is possible indeed to carry this standpoint through consistently whether one decides in favor of construction or axiom.

Let us consider the first alternative. Mathematics then consists primarily of construction. The occurring sets of axioms merely *fix the range of variables entering into the construction.* I shall explain this statement a little further by our examples of causal structure and topology. According to the special theory of relativity the causal structure is once for all fixed and can therefore be explicitly constructed. Nay, it is reasonable to construct it together with the topological medium itself, as for instance a circle together with its metric structure is obtained by carrying out the normal subdivision by cutting each arc into two *equal* halves. In the general theory of relativity, however, the causal structure is something flexible; it has only to satisfy certain axioms derived from experience which allow a considerable measure of free play. But the theory goes on by establishing laws of nature which connect the flexible causal structure with other flexible physical entities, distribution of masses, electromagnetic field, etc., and these laws in which the flexible things figure as variables are in their turn *constructed* by the theory in an explicit *a priori* way. Relativistic cosmology asks for the topological structure of the universe as a whole, whether it is open or closed, etc. Of course the topological structure can not be flexible as the causal structure is, but one must have a free outlook on all topological possibilities before one can decide by the testimony of experience which of them is realized by our actual world. To that end one turns to topology. There the topological scheme is bound only by certain axioms; but the topologist derives numerical characters from, or establishes universal connections between, arbitrary topological schemes, and again this is done by explicit construction into which the arbitrary schemes enter as variables. Wherever axioms occur, they ultimately serve to describe the range of variables in explicitly constructed functional relations.

So much about the first alternative. We turn to the opposite view, which subordinates construction to axioms and deduction, and holds that mathematics consists of systems of axioms freely agreed upon, and their necessary conclusions. In a completely axiomatized mathematics construction can come in only secondarily as construction of examples, thus forming the bridge between pure theory and its applications. Sometimes there is only *one* example because the axioms, at least up to arbitrary isomorphisms, determine their object uniquely; then the demand for translating the axiomatic set-up into an explicit construction becomes especially imperative. Much more significant is the remark that an axiomatic system, although it refrains from constructing the mathematical *objects,* constructs the mathematical *propositions* by combined and iterated application of logical rules. Indeed, drawing conclusions from given premises proceeds by certain logical rules which since Aristotle's day one has tried to enumerate completely. Thus on the level of propositions, the axiomatic method is undiluted constructivism. David Hilbert has in our day pursued the axiomatic method to its bitter end where all mathematical propositions, including the axioms, are turned into formulas and the game of deduction proceeds from the axioms by rules which take no account of the meaning of the formulas. The mathematical game is played in silence, without words, like a game of chess. Only the rules have to be explained and communicated in words, and of course any arguing about the possibilities of the game, for instance about its consistency, goes on in the medium of words and appeals to evidence.

If carried so far, the issue between explicit construction and implicit definition by axioms ties up with the last foundations of mathematics. Evidence based on construction refuses to support the principles of Aristotelian logic when these are applied to existential and general propositions in infinite fields like the sequence of integers or a continuum of points. And if the logic of the infinite is taken into account, it seems impossible to axiomatize adequately even the most primitive process, the transition $n \rightarrow n'$ from an integer n to its follower n'. As K. Gödel has shown, there will always be constructively evident arithmetical propositions which can not be deduced from the axioms however you formulate them, while at the same time the axioms, riding roughshod over the subtleties of the constructive infinite, go far beyond what is justifiable by evidence. We are not surprised that a concrete chunk of nature, taken in its isolated phenomenal existence, challenges our analysis by its inexhaustibility and incompleteness; it is for the sake of completeness, as we have seen, that physics projects what is given onto the background of the possible. However, it is surprising that a construct created by mind itself, the sequence of integers, the simplest and most diaphanous thing for the constructive mind, assumes a similar aspect of obscurity and deficiency when viewed from the axiomatic angle. But such is the fact; which casts an uncertain light upon the relationship of evidence and mathematics. In spite, or because, of our deepened critical insight we are to-day less sure than at any previous time of the ultimate foundations on which mathematics rests.

My purpose in this address has not been to show how the inventive mathematical intellect works in its manifold manifestations, in calculus, geometry, algebra, physics, etc., although that would have made a much more attractive picture. Rather, I have attempted to make visible the sources from which all these manifestations spring. I know that in an hour's time I can have succeeded only to a slight degree. While in other fields brief allusions are met by ready understanding, this is unfortunately seldom the case with mathematical ideas. But I should have completely failed if you had not realized at least this much, that mathematics, in spite of its age, is not doomed to progressive sclerosis by its growing complexity, but is still intensely alive, drawing nourishment from its deep roots in mind and nature.

SCIENTIFIC EVENTS

ANIMALS AND AIR RAIDS

A special correspondent of the London *Times* writes:

> A certain amount of fresh facts as to the effect of air raids on animals has now come in as a result of the appeal for information made in these columns some three weeks ago. So far as the London Zoo is concerned there is little to report. It is difficult to observe the animals' behavior at night when things are really happening. After a bad night, and during such day raids as there have been, they seem unconcerned. Almost all the society's geese are at the moment at Whipsnade, so that it has not been possible to confirm the reports that geese are peculiarly alert sentinels for air raids.
>
> However, some very interesting reports have come in from the Maidstone Zoo. In general, the experience there has been the same as in London—the animals show no reaction to the most violent air activity or anti-aircraft fire. On the other hand, the two chimpanzees, though they do not mind the guns, stamp and shriek at the sound of the siren. And of two emus, one is indifferent to noise, but the other gets so excited at the sound of the anti-aircraft guns and rushes about so violently that fears are entertained for its safety.
>
> A cow elephant about twenty years old is so sagacious that she hurries to her house if the anti-aircraft barrage catches her in the open, but once there does not seem to mind. Finally, one lion, normally a quiet animal, after a shell fragment hit him in his cage (doing little hurt as it had ricocheted off the bars), has become con-

ditioned to the anti-aircraft guns, starting to rip his cage to bits every time they start firing.

As regards wild birds, there is a good deal of evidence that many of the larger kinds are disturbed by the sound of bombs or anti-aircraft fire. With song-birds and other passerines, however, the chief reaction seems to be to aircraft. These are treated as if they were hawks, the birds scattering downwards and crouching to avoid detection. There are two curious exceptions to this: neither robins nor any member of the swallow tribe have been seen to pay the slightest attention to aircraft. The stories of gulls giving warning of the approach of hostile aircraft are presumably based on the same reaction: their keen senses—eyes more probably than ears—detect the aeroplanes a little before they are audible or visible to human beings.

Domestic animals vary individually. Some dogs have what may be called A.R.P. sense, and distinguish perfectly between the alert and the all-clear signals. One cat has been reported in this category; at the alert she comes indoors to take shelter, but when the raiders-passed signal is given she jumps up and scratches to be let out. She is indifferent to mere noise. Other dogs show no recognition of the difference between the sirens' signals. Again, some dogs do not mind the noise of guns and bombs, or even seem to like it, while others are miserably frightened and crawl under the furniture. Some parrots definitely dislike the noise, and scream loudly and hysterically.

EARTHQUAKES OF 1940[1]

Four strong distant earthquakes were registered at Kew Observatory during September. They were on September 12, 19, 21 and 22. The second of these was the greatest, having a ground amplitude at Kew of $47\,\mu$, and being estimated at a distance of 17,400 km. The second was at a distance of 6,100 km with an estimated depth of focus of about 390 km, whilst the third, probably distant about 140°, had a depth of focus of approximately 500 km. News from other observatories is awaited before the epicenters and depths of focus can be given with precision.

On September 4, two local earthquakes were felt in Palestine each of which lasted about 10 seconds. No damage has been reported and the shocks were not registered at Kew. It is reported in the press that an earthquake was felt in Copenhagen early on September 28. No damage was reported. Earthquakes are rare in this district and the shock may have been caused by fault slipping in the Sound separating Denmark from Sweden.

The coast of Chile in the neighborhood of Iquique was shaken by a violent earthquake about 6 A.M. (local time) on October 4. Reports of damage and details of the shock are not yet to hand. Chile as a whole is very liable to earthquake shocks, and Iquique has been affected on a number of occasions in the past, notably on May 9, 1877, when there was widespread destruction due to large sea waves caused by the earthquake in addition to the extensive damage done by the earthquake itself, and on January 23, 1878.

During April, May, June, 1940, forty-seven earthquakes were registered at the Riverview College Observatory, New South Wales, as compared with fifty-six in the first quarter of the year. The observatory is equipped with two Wiechert horizontal 1,000 kgm instruments, one Wiechert vertical seismometer of 80 kgm, two Mainka 450 kgm seismometers and three Galitzin aperiodic seismometers with galvanometer registration, orientated north-south, east-west and vertical. The largest two shocks of the period appear to have been on April 1 when an amplitude of 23 mm was obtained and on May 28 when an amplitude of 22 mm was reached. The shock of April 18 was felt in the region of the Duke of York Islands, New Britain, etc. The shock of May 24 is reported to have had its epicenter in Peru, and the earthquakes of June 18 and June 22 were deep focus shocks. The instruments are occasionally affected by microseisms which are at times severe. The microseisms do not often preclude the accurate reading of the seismograms, details of which are given in the observatory report.

FINANCES OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

In the annual report of President Karl T. Compton, of the Massachusetts Institute of Technology, the finances of the institute are discussed. The institute closed the year with a modest surplus. Of the budgeted expenditure of $3,333,000, slightly more than 69.3 per cent. was for academic expenses, 26.4 per cent. for plant and administration, and 4.3 per cent. for miscellaneous expenses. The yield on all investments, based on market values as of June 30, was 4.32 per cent. as compared with 3.89 per cent. a year ago.

Financial aid to students during the year amounted to $434,966, which included undergraduate scholarships to the sum of $93,830, and graduate scholarships and fellowships reaching a total amount of $111,618. Loans to students amounted to $162,843, and $66,675 was earned through the student employment service.

Commenting upon the institute's placement service for alumni and the graduating classes, Dr. Compton reported that the class of 1940 was more than 90 per cent. placed on September 1, and that the men of this class found employment in thirty different states. A number of those not placed include graduates who are entering private consulting or architectural practice.

Among the urgent needs of the institute are a new building for the department of chemical engineering, the largest in the institute, which is now greatly overcrowded. Plans for such a building have already been drawn and should the necessary funds be obtained, the new quarters would relieve congestion in a large part of the educational buildings on the eastern side of the institute. Attention was called to the need for new biological laboratories and the opportunities that could be realized by an increase in research funds of $200,000 a year or more.

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[1] From *Nature*.

Dr. Compton also pointed out that the large waiting list is evidence of the need of an additional dormitory unit, which could be immediately filled.

ACQUIREMENT BY HARVARD UNIVERSITY OF A DEPOSIT OF FOSSILS IN NORTHERN FLORIDA

DR. THOMAS BARBOUR, director of the Harvard Museum of Comparative Zoology, announces that a rich deposit of fossils in Gilchrist County, northern Florida, dating back some 18,000,000 years to the Miocene era, has been purchased by Harvard University for research purposes. The deposit, on a forty-acre farm site, contains the only reasonably complete store of Miocene fossils so far reported in the United States east of the Rocky Mountains. In preliminary excavations, Dr. Barbour and members of the museum staff found remains of several primitive horses, camels, dogs and rhinoceros. The deposit is expected to give the first good picture of land-life on the eastern seaboard during the Miocene period. All other eastern Miocene deposits are primarily of marine life.

Dr. Theodore E. White, of the museum staff, will work at the site this winter under a grant from the Milton Fund of Harvard University. Several years of excavation will be required to piece together the picture of the fauna as found in the fossil bones.

Fragments from the deposit have been on exhibit for some years at the museum of the Florida Geological Survey. These were seen several years ago by Dr. Barbour, who, with the aid of Mr. and Mrs. William E. Schevill, of the museum, located the site and made preliminary excavations. Last winter Drs. Barbour and White excavated for a longer period, finding some complete skulls and long bones. The specimens found at the end of the work last winter were better preserved than those found earlier, and it is probable that further digging will disclose material still better preserved.

EQUINE ENCEPHALOMYELITIS AND MOSQUITOES

EVIDENCE as to the guilt or innocence of mosquitoes in transmitting equine encephalomyelitis will be analyzed at the eleventh annual Conference of Mosquito Abatement Officials in California, to be held at the University of California at Berkeley, on December 16.

Speakers and their subjects, announced by S. F. Dommes, Jr., secretary, are as follows:

Epidemiology and Distribution of Human Cases, Dr. H. L. Wynns, chief, Bureau of Epidemiology, California State Department of Public Health.

Distribution of Cases in Horses and the Economic Importance of Equine Encephalomyelitis in Horses, Dr. C. U. Duckworth, administrator, Division of Animal Industry, California State Department of Agriculture.

Relationship of Distribution of Cases and Mosquitoes, Thomas H. G. Aitken, University of California.

Investigations of Equine Encephalomyelitis in Kern County, Dr. W. C. Buss, epidemiologist, Kern County Health Department.

Present Information on Experimental Transmission of Equine Encephalomyelitis by Mosquitoes, Dr. Malcolm H. Merrill, California State Department of Public Health.

Professor W. B. Herms, head of the Division of Entomology and Parasitology of the University of California, will introduce the symposium, and a summary of the discussion is to be presented by Dr. Bertram P. Brown, director of the California State Department of Public Health.

Representatives from twenty-five mosquito abatement districts and from health departments and universities in California ordinarily attend the conference. This year, invitations have also been sent to state universities and health departments in Washington, Oregon, Montana, Idaho, Nevada, Utah, Arizona, Colorado and New Mexico.

Methods of organizing mosquito abatement districts, experiences in mosquito control as a health department function and various operating problems will also be considered at the conference. William Reeves, a graduate entomologist at the University of California, will report on research on the Pacific Coast "tree-hole" mosquito, *Aedes varipalpus.*

THE ROLE OF DENTISTS IN NATIONAL DEFENSE

THE American Dental Association at its recent meeting in Cleveland used as a general theme the national defense and the special role of the dental profession in it. A nation-wide dental health census, conducted by the Committee on Economics, indicated that "the nation, from a dental standpoint, is woefully unprepared to meet the exacting requirements in industry and the military services in a time of possible national emergency." Although the data from this survey have not been entirely worked over, Dr. R. M. Walls, chairman of the Committee on Economics, told the House of Delegates of the association that "after careful consideration of the figures now available, we must face the fact that an immediate effort must be made by dentistry to meet a situation which may have a serious effect on the whole defense program."

Because of the national condition thus indicated, and drawing on experience in the last war concerning dental health in the army and in industry, the American Dental Association adopted a three-point program to mobilize America's dental resources for national defense as follows:

(1) Sending to every registered dentist in the nation a questionnaire giving complete information on the dental personnel available for military purposes and for civilian needs.

(2) Launching a program for cooperation with the Surgeon-General of the Army and Navy to reduce the percentage of rejections for dental defects among volunteers and prospective draftees under the conscription law.

(3) Setting in motion a special education program for dentists by distributing courses in military dentistry now under preparation by the War Department.

MEMORIALS

EXERCISES in honor of the centennial of the death of Constantine Rafinesque were held at Transylvania College, on October 30. An address was given before the student convocation by Dr. Francis W. Pennell, of the Philadelphia Academy of Natural Sciences, and at the luncheon by Dr. A. E. Emerson, of the University of Chicago, who spoke on "The Modern Naturalist." In the afternoon there was a symposium entitled "Rafinesque's Interests—a Century Later," at which Dr. W. D. Funkhouser, of the University of Kentucky, spoke on "Archeology in Kentucky"; Dr. W. E. Ricker, of Indiana University, on "Research in the Biology of Fish" and Dr. W. M. Clay, of the University of Louisville, on "Herpetology." At the dinner addresses were given on "The Life and Works of Rafinesque" by Dr. Francis W. Pennell, and on "Constantine Rafinesque, the Man," by Dr. L. R. Dingus. The remains of Rafinesque were removed from Philadelphia in 1923 and were placed in a crypt on the campus of Transylvania College. The college has in its possession a collection of the manuscripts, books and letters, and two of the three known portraits of Rafinesque.

WASHINGTON AND JEFFERSON COLLEGE, Washington, Pa., dedicated on October 26 a new building for chemistry to the memory of Dr. Jesse W. Lazear, who died in Cuba in 1900 of yellow fever while serving as a member of the Yellow Fever Commission of the U. S. Army. Dr. Lazear was an alumnus of the college. John R. Kissinger, Huntington, Ind., and John J. Moran, Habana, Cuba, two of the group of soldiers who allowed themselves to be bitten by mosquitoes during the investigation, were guests at the dedication ceremonies. At a banquet in the evening Dr. Philip S. Hench, of Rochester, Minn., made an address on the work of the Yellow Fever Commission. The Jesse W. Lazear Chemistry Hall is one of three buildings dedicated. One of these was named in honor of the late Dr. Edwin Linton, for many years professor of biology and geology at Washington and Jefferson College.

THE "Cradle of Dental Education in America" will be dedicated on November 24 by the Ohio State Dental Society at Bainbridge. This dental monument is a small brick building which served as the office of Dr. John Harris from 1825 to 1850. It has been purchased and restored by the society and will be maintained as a permanent museum and memorial. Addresses will be given at the dedication by Dr. B. W. Weinberger, Dr. Arthur H. Merritt and Dr. J. Martin Fleming. Dr. Harris served as preceptor to a group of students, several of whom later became prominent in dental education and practice. Dr. Chapin A. Harris received his dental training at the Ohio State University and then went to Baltimore. There he and Dr. Horace Hayden founded, in 1840, the first chartered dental college in the world, the Baltimore College of Dental Surgery. Dr. James Taylor also secured his dental training under Dr. John Harris and in 1845 founded the second dental college. This was the Cincinnati College of Dental Surgery whose influence was, perhaps because of its central location, more far-reaching than that of the Baltimore School.

SCIENTIFIC NOTES AND NEWS

DR. HENRY E. SIGERIST, professor of the history of medicine and director of the Institute of the History of Medicine at the Johns Hopkins School of Medicine, and Dr. Esmond R. Long, professor of pathology at the University of Pennsylvania and director of the Henry Phipps Institute, have been elected honorary members of the athenaeum of the chair of the history of medicine in Buenos Aires.

ON the occasion of the installation of President Kenneth Irving Brown at Denison University on October 18, the degree of doctor of science was conferred on Daniel Sheets Dye, who has been head of the department of science at Union University, Chengtu, West China, since 1910.

CITATIONS of merit have been awarded by the Park Association of New York City for "outstanding service" to the parks of the city. The nine awards made included one to Dr. W. Reid Blair, who retired as director of the New York Zoological Park last May. Dr. Blair joined the staff of the park in 1902, and was appointed director in 1926. The citation said that for thirty-eight years he had carried out his work at the New York Zoological Park with "untiring zeal and devotion."

Nature states that the Academy of Sciences of the USSR has awarded the Pavlov Prize for 1940 to Professor Maria K. Petrova, of the Pavlov Institute of Physiology and the Institute of Evolutionary Physiology and Pathology of the Higher Nervous Activity, who is known for her study of experimental neuroses, their mechanism and therapy. The annual Pavlov Prize of 20,000 roubles, for the best work in the field of physiology, was instituted by the Soviet Government in 1936.

Dr. Frederick B. Hutt, professor and head of the department of poultry husbandry and animal genetics at Cornell University, has been appointed head of the department of zoology in the College of Agriculture and professor of zoology and chairman of that department in the College of Arts and Sciences. Dr. Herbert Bruckner has been appointed acting head of the department of poultry husbandry.

Dr. Lyman E. Jackson, junior dean of the College of Agriculture of the Ohio State University, has been elected president of the South Dakota State College of Agriculture and Mechanic Arts at Brookings. He will also be head of the South Dakota Agricultural Experiment Station and of the Agricultural Extension Service.

Changes in the department of physics of Harvard University are as follows: Professor G. W. Pierce has retired and Professor E. L. Chaffee has taken his place as director of the Cruft Laboratory. Professor N. H. Black has also retired. Professor F. A. Saunders has resigned the chairmanship of the department and Professor E. C. Kemble has been appointed to succeed him.

Professor Gertrude M. Cox, of the Statistical Service of the Iowa State College, has become director and head of a newly organized laboratory of experimental statistics at North Carolina State College.

Dr. R. C. Ernst, professor and head of the department of chemical engineering, has been appointed director of the Division of Industrial Research at the Speed Scientific School of the University of Louisville, Kentucky.

John G. Dean recently resigned his position with the Permutit Company as director of the Laboratory Research Division to become a member of the science faculty of Sarah Lawrence College, Bronxville, N. Y.

The following appointments have been made at Parsons College, Fairfield, Iowa: Dr. J. R. Jenness, of the College of the Ozarks, head of the department of physics and mathematics; Dr. S. Porter Miller, of Buena Vista College, head of the department of chemistry; Dr. J. W. Hancock, of Michigan City, Ind., High School, assistant professor of psychology; Miss Louise Reed, Westphalia, Kans., High School, head of the department of home economics; Malcolm McDonald, of the State University of Iowa, assistant professor of biology.

Dr. W. A. Clemens, director of the Pacific Biological Station at Departure Bay, Canada, has been appointed head of the department of zoology of the University of British Columbia.

Dr. Antonio G. Sison, dean of the College of Medicine, has been appointed director, and Dr. Agerico B. M. Sison, assistant professor of medicine, secretary, of the newly established Post-Graduate School of the College of Medicine of the University of the Philippines.

Dr. Thomas F. Anderson, instructor in physical chemistry at the University of Wisconsin, has been awarded the RCA Electron Microscope Fellowship. In collaboration with the Fellowship Committee, by whom he was appointed, Dr. Anderson will devote a year to research at the RCA Research Laboratory at Camden, N. J., with the electron microscope which was recently developed in the research laboratories of the corporation, and has now been made available for research workers. Dr. Stuart Mudd, of the School of Medicine of the University of Pennsylvania, is chairman of the committee of award. Other members are Dr. M. Demerec, Station of Experimental Evolution, Carnegie Institution of Washington; Dr. J. H. Kempton, U. S. Bureau of Plant Industry; Dr. C. W. Metz, department of zoology, University of Pennsylvania; Dr. W. M. Stanley, Rockefeller Institute for Medical Research, Princeton, N. J.; Dr. Caryl P. Haskins, Haskins Laboratories, and Dr. V. K. Zworykin, RCA Research Laboratories. The terms of the fellowship provide for investigation of biological problems with the RCA electron microscope, and for experimentation to develop techniques for obtaining the fullest benefits from the electron microscope.

The Institute of Medicine of Chicago announces that the Elizabeth McCormick Child Research Grant of $1,500 for 1940–41 has been divided among Dr. Clayton J. Lundy, Dr. Mila I. Pierce and Dr. Heyworth N. Sanford for the continuation of the investigations begun under their 1939–40 grants, Dr. Lundy's on heart sound records in rheumatic heart disease, Dr. Pierce's on leukosis, and Dr. Sanford's on the role of qualitative platelet factors in the coagulation of the blood.

F. G. Friedlander, who was born in Germany, but was educated in England, has been elected to a fellowship at Trinity College, Cambridge, for his contributions to mathematics. Mr. Friedlander is at present interned in Canada, on account of his German origin.

Dr. John B. Youmans, associate professor of medicine and director of postgraduate instruction in the School of Medicine of Vanderbilt University, who has leave of absence to serve as a member of the Health Commission of the Rockefeller Foundation, has sailed for Europe. Dr. Youmans will serve as dietitian in charge of the nutritional phases of the health program of the commission. The work of this commission, consisting of six or eight specialists in medical and health fields, will be to aid the French in reestablishing and reorganizing the health service of that country.

DR. DANIEL MELNICK, of the University of Michigan, has been appointed chief chemist of the Food Research Laboratories, Inc., of which Dr. Philip B. Hawk is director.

DR. MELVILLE T. COOK, plant pathologist at the Agricultural Experiment Station at Rio Piedras, Puerto Rico, who retired on July 1, will make his headquarters for the present with his son, Dr. Harold T. Cook, at the Virginia Truck Experiment Station at Norfolk, Va.

DR. HENRY E. SIGERIST, director of the Institute of the History of Medicine at the Johns Hopkins University, is delivering at Cornell University a series of six Messenger Lectures on "Civilization and Diseases."

DR. EDWARD L. THORNDIKE, professor emeritus of psychology at Teachers College, Columbia University, gave on November 13 a lecture entitled "The Development, Retention and Attraction of Superior Men" at a meeting of the American Academy of Arts and Sciences.

PROFESSOR ROBERT S. WOODWORTH, of Columbia University, will give an address entitled "Recent Results on Heredity and Environment" at a meeting to be held at the American Museum of Natural History on November 18 of the Section of Psychology of the New York Academy of Sciences.

DR. QUINCY WRIGHT, professor of international law at the University of Chicago, gave an address on October 31 at a joint meeting of the Chicago branch of the American Association of Scientific Workers and the Midwest Association of Sigma Xi. He spoke on "The Influence of Invention on Warfare."

DR. KARL K. DARROW, of the Bell Laboratories, Inc., of New York, addressed the student body of Rutgers University on November 13 on the occasion of the second of the series of seven convocations celebrating the one hundred and seventy-fifth anniversary of its founding. He spoke on "New Radio-Active Substances Produced by Transmutation." In the afternoon a symposium was conducted by Dr. Darrow, at which members of the faculties of the science departments, advanced students, physicists from industrial organizations in the vicinity and from neighboring colleges and universities were present.

THE second annual meeting of the Sigma Xi Club of Hawaii was held on October 18 at the University of Hawaii. Election of seven new members brought the membership up to seventy. New officers elected for the ensuing year are: *President,* Dr. C. H. Edmondson, professor of zoology, University of Hawaii; *Vice-president,* Dr. J. H. Beaumont, director, Hawaii Agricultural Experiment Station; *Secretary-treasurer,* Dr. S. S. Ballard, assistant professor of physics, University of Hawaii; *Councilors,* C. E. Pemberton, executive entomologist, Experiment Station of the Hawaiian Sugar Planters' Association; Dr. J. L. Collins, geneticist and acting director, Experiment Station, Pineapple Producers Cooperative Association, and Dr. C. J. Hamre, *ex-officio,* professor of zoology, University of Hawaii. The address of the evening was given by the retiring vice-president, Dr. Martha Potgieter, associate nutritionist, of the Hawaii Agricultural Experiment Station. She spoke on "The Family Diet and Its Relation to Child Health," a report of the findings to date of the Nutrition Department of the Hawaii Agricultural Experiment Station regarding local food habits, adequacy of family diets and possible effects of dietary deficiencies on the physical and dental status of children in Hawaii.

THE fourteenth annual meeting of the Colorado-Wyoming Academy of Science was held on October 18 and 19 at the University of Wyoming. One hundred and twenty-five papers were presented. President Roy M. Green, of the Colorado State College of Agriculture and Mechanic Arts, gave the main address, which was entitled "A Scientific Approach to Agricultural Problems." The newly elected officers are: *President,* Dr. C. T. Hurst, Western State College, Gunnison; *Vice-president,* Dr. Wm. Warren Howe, Colorado School of Mines, Golden; *Executive Secretary,* Dr. Essie White Cohn, University of Denver, and *Treasurer,* Dr. Charles F. Poe, University of Colorado.

IN order to ensure opportunities for the publication of the scientific results of cancer research, a group of representatives of interested organizations will cooperate in making possible a new journal, to be called *Cancer Research,* to be devoted to articles and abstracts of articles having to do with cancer research. This journal is sponsored by the American Association for Cancer Research, the Anna Fuller Fund, The International Cancer Research Foundation and The Jane Coffin Childs Memorial Fund for Medical Research. The conduct of the journal will be in the hands of an Advisory Board consisting of the chairman of the editorial committee and representatives of the contributing Funds, an editorial committee and a business manager. Those serving are: *Advisory Board:* S. Bayne-Jones, representing The Jane Coffin Childs Memorial Fund for Medical Research; C. C. Little, as chairman of the Journal Committee of the American Association for Cancer Research; James B. Murphy, as chairman of the Editorial Committee of *Cancer Research;* Mildred W. S. Schram, representing The International Cancer Research Foundation, and G. M. Smith, representing the Anna Fuller Fund. *Members of the Editorial Committee* are: James B. Murphy, *chairman;* S. Bayne-Jones, for immunology and the viruses, and secretary of the committee; John Bittner, for genetics; Alexander Brunschwig, for physiology; L. F. Fieser, for organic chemistry; Jacob Furth, for the leukemias; W. U. Gardner, for hormones; Balduin Lucké, for general biology, including tissue culture and cytology; M. J. Shear, for biochemistry, and Shields Warren, for pathology. The business manager is A. Vaughn Winchell, American Oncologic Hospital, Philadelphia. It is hoped to start publication with the issue of January, 1941. Manuscripts should be addressed to the Secretary of the Editorial Committee, 333 Cedar Street, New Haven, Conn.

A "Bibliography on Arthogonal Polynomials" has been published as a Bulletin of the National Research Council. A Committee of the council, consisting of Professors Hille (Yale), Shohat (Pennsylvania), and Walsh (Harvard) has spent several years in the compilation of the bibliography, with the cooperation of several other mathematicians here and abroad. The Faculty Research Committee of the University of Pennsylvania and its Sigma Xi Chapter has given financial aid.

THE British Royal College of Physicians has announced that the Harveian Oration, the Bradshaw, the Fitzpatrick and the Lumleian Lectures for 1940 have been postponed.

IN spite of the war, the Engineering Societies Library reports that it is experiencing no difficulty in its receipt of technical periodicals from Great Britain. However, only a few engineering magazines reach the library now from continental Europe. The three hundred and fifty or more periodicals from England and other parts of the British Empire are coming through with unusual regularity except in one or two instances since the beginning of the war when the ship carrying a batch of them was sunk by a torpedo or a mine. However, correspondence with the publishers soon brought replacements for all lost copies. The Allied blockade of Germany failed to stop the flow of German magazines to the library through Italy. But, with the entrance of the latter country into the war, the library failed to receive German and Italian publications for several months. Now, some of the German periodicals are being received again through Siberia and Japan, as indicated by the postmarks on the wrappers. *Genie Civil* and other French periodicals ceased arriving a few weeks after the surrender of France. To avoid the loss of valuable publications being sent to and received from the British Isles and continental Europe through exchange agreements between engineer institutions there and the Engineering Societies Library and its cooperating organizations, arrangements have been completed to store them in the country of origin until the end of hostilities. Similar arrangements during the world war proved so satisfactory that only one or two sets of foreign periodicals failed to be completed with the resumption of commerce between belligerents.

DISCUSSION

CORAL-REEFS AND THE FORMATION OF PETROLEUM

IN his recent article on the "Progress in Petroleum" Egloff[1] has presented a brief discussion of a theory of continual petroleum formation from marine sediments, as for example diatoms, foraminifera and radiolaria. In reference to this theory the preliminary results of investigations which are in progress in this laboratory may be of some interest, because they indicate that coral-reefs should also be taken into consideration as one of the possible sources of petroleum.

Reef-building corals contain a by no means inconsiderable quantity of organic material. One hundred years ago, Silliman[2] in his classical paper on the composition of stony corals has stated that the organic matter of various corals amounted to from 4 to 8 per cent. of the total, and that it was intimately united with the inorganic material throughout the structure of the coral. Silliman's observations have been verified in recent years by Clarke and Wheeler[3] (1922), who found that the organic matter of twenty-eight species of corals amounted to from 2 to 7 per cent. It is also of considerable interest that Silliman called attention to the fact that part of the organic matter consists of some wax-like material which can be separated from its inorganic surroundings by boiling with water. After the boiling of the corals it was found floating on the surface of the water in "transparent, jelly-like masses of yellowish color. It was insoluble in alcohol, but readily so in cold ether, and the evaporation of its ethereal solution yielded a yellow solid, resembling wax." Since Silliman's time practically no work has been done on the organic constituents in corals, which is rather surprising because the reef-building corals occur in almost unlimited abundance in the coastal regions of tropical waters.

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[1] G. Egloff, SCIENCE, 91: 533, 1940.

[2] B. Silliman, *Am. Jour. Sci.*, (2) 1: 189, 1846.

[3] F. W. Clarke and W. C. Wheeler, *U. S. Geol. Surv. Paper* No. 124, Government Printing Office, Washington, 1922.

In the course of a systematic study of the steroids of lower marine animals, the lipoid fractions of a number of stony- or reef-corals (Madreporaria) and sea-fans (Gorgonaceae) were prepared at this laboratory. It was found that these fractions represent a not inconsiderable proportion of the starting material. In the case of the staghorn coral, *Madrepora cervicornis,* concentration of its acetone extract led to the precipitation of a low-melting, crystalline, wax-like material in a yield of about 0.25 per cent. of the total mass of corals. After frequent recrystallizations the wax melted at 50–50.5°; it was identified as pure cetyl palmitate. The remaining extracts of the coral were saponified, and the non-saponifiable fraction, which amounted to 0.25 per cent. of the total, was separated into three fractions containing the following groups of compounds: (A) sterols precipitable with digitonine, (B) non-steroid alcohols, and (C) non-alcoholic compounds like hydrocarbons and ketones. Fraction A consisted of a mixture of sterols containing at least one unknown sterol giving an acetate of m.p. 176°. Fraction B consisted almost exclusively of cetyl alcohol and fraction C of low-melting hydrocarbons and small amounts of ketones. Similar results were obtained with the coral *Meandra areolata,* which contained about 0.3 per cent. non-saponifiable material consisting of cholesterol, an unknown sterol, cetyl alcohol, hydrocarbons and possibly some ketones. The results so far available indicate that stony corals contain from 0.3 to 0.5 per cent. of non-saponifiable material or about 10 per cent. of the total amount of organic material present.

The sea-fans (Gorgonaceae) which also contribute to reef formation are much more abundant in non-saponifiable material than the stony corals. In certain species the calcareous outside layers contain as much as 3 per cent. For example: 1,000 g. of dried and crushed external layers of a brown Gorgonia from Florida gave 33 g. of non-saponifiable material or 3.3 per cent. It consisted of about 20 per cent. of an unknown sterol, 50 per cent. of alcohols (cetyl alcohol) and 30 per cent. of semi-solid hydrocarbons. 1,100 g. of layers of a yellow Gorgonia gave 2 per cent. of non-saponifiable material consisting of about 30 per cent of an unknown sterol, 30 to 40 per cent. of other alcohols and the remainder of a mixture of hydrocarbons and possibly ketones which was liquid at room temperature. The compounds described can be isolated equally well from dried, but unbleached old museum specimens as from freshly collected material.

The presence of such sizable quantities of lipoid material in reef-building animals seems rather significant. It is not confined, as has already been pointed out by Silliman, to the relatively thin living layer, but extends deep into the entire structure of the coral. In view of these findings the idea at once suggests itself that coral reefs may act as gigantic accumulators of "wax-like" substances, especially of the chemically inert hydrocarbons. The bulk of the organic matter of dead marine animals and plants is probably brought back into circulation one way or the other. In the case of the reef-building animals, however, a significant portion of the organic matter becomes trapped in the ever-growing inorganic skeleton and hence is removed from further circulation. If this is indeed the case we must conceive the coral reefs as vast storehouses of compounds which may be considered as potential precursors of petroleum. At some time changes in the physical conditions may loosen this material from its inorganic surroundings and bring it to the surface, similar to the wax-like material which Silliman found floating on the surface of water in which corals had been boiled. The authors of the present article are not petroleum chemists and they do not claim the complicated problem of the formation of petroleum can be solved merely on the basis of the coral reefs. They present their preliminary findings only in order to call attention to the coral-reefs as one of the possible sources of petroleum and to stimulate discussion along this line.

Werner Bergmann
David Lester

Yale University

THE OCCURRENCE AND ISOLATION OF AZOTOBACTER IN CHINESE SOILS[1]

On account of their relation to soil fertility, the non-symbiotic nitrogen fixation bacteria, Azotobacter, have received considerable attention since their discovery by Beijerinck in 1901. They are widely distributed in the soils throughout the world, as their occurrence has been reported in the soils of Java, India, Poland, the United States, England, Japan, Russia, etc. The only country whose soils are completely devoid of this microorganism is Finland.[2] As yet, however, there is no information about their occurrence in the vast area of Chinese soils.

The purpose of the present study is to make a general survey of the occurrence of Azotobacter in the soils of Szechuen Province, which, under the present circumstances, is probably the most important agricultural region in China. The work also involves the isolation of pure cultures from the soils for experimental works which the writer is planning to carry out in the near future.

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[1] The detailed report of this work will appear in *Soil Bulletin* (bimonthly publication, National Geological Survey, Ministry of Economics, China).

[2] W. Brenner, *Geol. Komm. Finland Agrogeol. Meddel.*, 20: 1–15, 1924.

The soil samples, including as many as fifteen or more types, were collected under more or less sterile conditions from various parts of the province, particularly the northwestern section. They are composite samples taken from the soils at a depth of about 20 to 30 cm below the surface.

The presence of Azotobacter in the soils was determined by using mannitol, dextrin or other simple carbohydrates in liquid media, and the results so obtained were checked by using either the nitrogen-free nutrient agar medium of Martin, Walker and Brown[3] or soil plaque methods of Winogradsky.[4] As a rule, two or three independent determinations were made for each sample.

Of all the 127 soil samples collected and determined, 102 or 78.2 per cent. contained Azotobacter. This finding is not surprising in view of the fact that in other countries over 50 per cent of the soils containing Azotobacter is not uncommon, as reported by various workers, and furthermore, the soils of Szechuen Province are well known to be very fertile.

Isolation of the pure cultures was carried out during the progress of the survey. The media used were nitrogen-free agar media of various kinds. Repeated purifications were made by using congo red nitrogen-free agar medium of Bryan.[5] This medium proves to be very useful in purification especially in separating Azotobacter from their most common contaminants, Radiobacter.

The strains isolated from this survey are mostly *Azotobacter chroococcum* although a few of them are not yet definitely identified.

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PRODUCTION OF SYMPTOMS BY SUBCUTANEOUS INJECTION OF HISTAMINE WITHOUT INCREASE OF THE BLOOD HISTAMINE[1]

Histamine has been used to produce experimental shock by many investigators, and at one time it was thought to be one of the toxic factors responsible for the production of shock following trauma. Since it was impossible to detect histamine in the circulating blood under these conditions, this substance was rejected as a possible cause by many workers. It was stated that when symptoms of shock were produced by the injection of histamine, large amounts of this substance were present in the circulating blood and therefore easily detectable.[2]

In order to note the changes in the blood histamine following the production of symptoms by the subcutaneous injection of this substance, the following procedure has been carried out in ten patients. A control blood is taken, blood-pressure and pulse being noted. One mgm of histamine diphosphate is then injected subcutaneously and the blood histamine determined, at 5, 15, 30 minutes and one hour, blood-pressure and pulse being recorded at the same time. In each instance symptoms of histamine intoxication were noted, such as an increase in pulse, decrease in blood-pressure, flushing of the face and the onset of headache. In no case, however, was an increase of blood histamine observed, even at the height of the symptoms. It was also noted that the particular allergic symptoms were reproduced if the patient on whom the test was being carried out was an allergic individual. The relationship of blood histamine to allergy is being reported elsewhere.[3]

In the light of these findings, therefore, it appears that histamine intoxication may occur without an increase in the peripheral blood histamine. Failure to demonstrate an increase in the peripheral blood histamine does not exclude the possibility that this substance may be responsible for the symptoms of shock.

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AGASSIZ AND LIEBIG

The year 1940 should not be allowed to pass without noting that it marks the centenary of the publication of two papers whose contents have profoundly influenced the history of agronomy and of its offspring, soil science. These papers were "Etudes sur les glaciers," in two volumes, by the Swiss naturalist Louis Agassiz, and "Die Chemie in ihrer Anwendung auf Agriculture und Physiologie" by the German chemist Justus von Liebig.

Born within a few hundred miles of each other, the lives of these scientists were contemporaneous and almost conterminous. Agassiz, by his glacial hypothesis, solved the riddle of the origin of the surficial deposits of a large portion of the northern hemisphere. Liebig, with his mineral theory of plant nutrition, gave the world the scientific basis for the use of mineral fertilizers. Both men greatly stimulated research in their respective fields. Agassiz traveled in America, and liked the United States so well that he accepted the offer of a professorship in Harvard University and settled in this country.

A. B. Beaumont

Massachusetts State College

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[3] Martin, Walker and Brown, *Research Bull.* 217, Iowa Agr. Exp. Sta., 1937.

[4] S. Winogradsky, *Ann. Inst. Pat.*, 40: 455–520, 1926.

[5] C. S. Bryan, *Soil Science*, 45: 1938.

[1] Aided by a grant from the Banting Research Foundation.

[2] C. A. Dragstedt and F. B. Mead, *Jour. Am. Med. Ass.*, 108: 95, 1937.

[3] *Journal Allergy* (in press).

THE NATIONAL ACADEMY OF SCIENCES

ABSTRACTS OF PAPERS

(Continued from page 419)

The establishment of precise spectrophotometric constants for hemochromogens and Cytochrome C, upon an iron basis, and the analysis of the Cytochrome C spectrum: DAVID L. DRABKIN[1] (introduced by W. M. Clark). A new method[2] has been modified appropriately and adapted successfully to the accurate determination of iron in such organic complexes as hemin and Cytochrome C. The iron, freed from the complex and reduced under controlled pH conditions, is converted into ferrous orthophenanthroline, which has an absorption maximum at wave-length 500 mμ. The light transmission (from which the extinction is calculated) was determined by precise, visual spectrophotometry, or by means of a photoelectric filter photometer of new design (to be described elsewhere). 10 mg samples of Cytochrome C, the purest preparations of which contain 0.43 per cent. iron, were sufficient for accurate analysis. The precision of the method was equal to that of spectrophotometry under optimal conditions. Using the iron content as the basis for the concentration of total pigment, spectrophotometric constants, ε[3] ($C = 1$ mM per liter (iron equivalent basis), $d = 1$ cm, spectral interval $= 1.5$ to 2 mμ), were established for dipyridino ferroporphyrin (a synthetic hemochromogen) and Cytochrome C.

The kinetics of the enzyme-substrate compound of peroxidase and their relation to the Michaelis theory: BRITTON CHANCE, J. G. BRAINERD, F. A. CAJORI and G. A. MILLIKAN (introduced by A. N. Richards). A study of the kinetics of the formation and breakdown of the enzyme-substrate compound of peroxidase has been carried out by means of a photoelectric method for measuring rapid changes in the violet absorption spectrum of the enzyme. Under the same conditions, photoelectric measurement of changes in the red absorption spectrum of malachite green were recorded as leuco-malachite green was oxidized by peroxidase and hydrogen peroxide. The complete cycle of enzyme operation was recorded: the rapid formation of the enzyme-substrate compound, the enzyme operation at constant concentration of enzyme-substrate compound and the decrease in concentration of this compound when the substrate was used up. Correspondingly, the rate of formation of malachite green started slowly, accelerated to a large constant value, and then fell to zero. Thus the operation of the enzyme-substrate compound has been directly related to the over-all enzyme action. The Michaelis affinity for peroxidase, determined by direct measurement of the concentration of enzyme-substrate compound as a function of substrate concentration, was found to be in agreement with the values obtained elsewhere by measurement of the rate of malachite green formation. Solutions of the differential equations representing the Michaelis theory were obtained by the University of Pennsylvania differential analyzer and fitted the observed data in curve shape, time scale and concentration values over a part of the experimental range.

The synthesis of chroman derivatives: RALPH CONNOR and PETER L. DE BENNEVILLE (introduced by M. H. Jacobs). The synthesis of chromans received relatively little attention until it was discovered in 1938 that the tocopherols (Vitamin E) were chroman derivatives. In the last two years the chemistry of this series has been studied in a number of laboratories with the result that good methods are now available for the synthesis of 2,2-dialkylchromans. These methods, however, are not applicable to the synthesis of chromans with substituents in the *3* and *4* positions. The present report describes a new synthesis of chromans which should be applicable to the synthesis of any chromans except those with substituents in the *2* position. The hydrogenation of coumarin over copper chromite at 250° and under a hydrogen pressure of 2,000–3,000 pounds per square inch gave o-(γ-hydroxy-propyl)-phenol (85–90 per cent.). This phenolic alcohol, upon treatment with phosphorus tribromide, gave chroman (85–90 per cent.). By the application of this method to substituted coumarins, 4,7-dimethylchroman, 6-methylchroman, 7-methylchroman, 7,8-benzochroman and 7,8-tetrahydrobenzochroman were obtained. From 4-methyl-6-hydroxycoumarin the product was 4-methyl-6-hydroxy-hexahydrochroman. When nickel was used as a catalyst at 250°, hydrogenated chromans were the chief products obtained from coumarins. This is the first synthesis of compounds of this type. By this method the completely hydrogenated derivatives corresponding to all the chromans named above were isolated. These results indicate that coumarins, which are fairly readily prepared by known methods, may be readily converted to either chromans or hexahydrochromans by selection of the appropriate catalyst.

Sulfonyl ureas: EDWARD H. COX (introduced by C. E. McClung). Only two methods for the preparation of sulfonyl ureas are recorded in the literature. One, the ammonolysis of sulfonyl isocyanates is dangerous to carry out and gives low yields of desired product, the second, the reaction of potassium cyanate on sulfonamides is not duplicatable. We, therefore, set out to find our own method. Attempts to treat urea with sulfonyl chlorides under varying conditions, acid and alkaline ($Ba(OH)_2$) hydrolysis of sulfonyl quanidines, and acid hydrolysis of sulfonyl alkylthioureas, failed. Ammonolysis of sulfonyl urethanes also failed. We have found that the sulfonyl alkyl isoureas can be hydrolyzed to the ureas in good yields. The base, ethyl isourea is prepared as the hydrochloride salt when cyanamide dihydrochloride and cyanamide is treated with ethyl alcohol under pressure. The sulfonyl isoureas are prepared by treating the sulfonyl chloride and the isourea salt with the proper amount of alkaline solution. The sulfonyl isoureas are then hydrolyzed to the corresponding ureas by hydrochloric acid.

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[1] Fellow of the John Simon Guggenheim Memorial Foundation at the Department of Physiological Chemistry, Johns Hopkins School of Medicine. Part of this work was done during tenure of the fellowship.

[2] O. Schales, Personal communication. W. Lintzel, *Z. ges. exp. Med.*, 86: 269, 1933. G. Barkan and B. S. Walker, *Jour. Biol. Chem.*, 131: 447, 1939; 135: 37, 1940.

[3] ε, unmodified, is the symbol for *extinction* and is equal to $-\log \tau$ (*transmission*, expressed as a fraction).

This work is preliminary to the preparation of sulfonyl ureas derivatives in the sulfanilamide series.

Mono- and polyhydroxyprogesterones: **Maximilian Ehrenstein** and **Thelma O. Stevens** (introduced by A. N. Richards). The hormones of the adrenal cortex represent hydroxyprogesterones in which the side chain of the steroid molecule carries a primary alcohol group. In addition, one or two hydroxyl groups may be attached to the nucleus. It has been possible to obtain by synthetic chemical procedures hydroxyprogesterones which are different from the naturally occurring compounds and to subject them to a physiological examination. These compounds will be briefly discussed with reference to the subject of steroid structure and biological activity.

The gonadotropic hormone of urine of pregnancy: **Samuel Gurin, Carl Bachman** and **D. Wright Wilson** (introduced by A. N. Richards). The gonadotropic hormone of pregnancy urine has been prepared in a high state of purity. It is a glycoprotein and has been studied by physical and chemical methods. The crude hormone was obtained from fresh urine collected from women about two months pregnant by Katzman and Doisy's adsorption method on benzoic acid. This material assaying 30–50 minimal effective doses (Friedman Units) per mg was extracted with 50 per cent. ethanol at pH 6.0 and the derived product extracted with the same solvent at pH 4.8. Preparations assaying from 1,000 to 3,000 Friedman units were obtained. Further purification was accomplished by shaking a solution of the hormone with chloroform and dialyzing the resulting solution. The material obtained by precipitation with acetone had an activity of 4,000 Friedman units. All manipulations were carried out at about 0° C. Our best material was apparently well purified because it showed homogeneity in the ultracentrifuge and the Tiselius apparatus. The protein contains 15 per cent. carbohydrate. Two thirds of the carbohydrate is galactose and one third a hexosamine. The material is unstable in dilute solution at 0° C. An approximation suggests that the minimum molecular weight is about 80,000. Comparisons of our assay method with the International Standard indicate that our preparation which assays 4,000 Friedman units per mg contains about 8,000 international units per milligram.

Preparation of crystalline pepsin having the properties of a pure protein: **Roger M. Herriott, Victor Desreux** and **John H. Northrop**. The three most commonly accepted tests for the purity of a protein are homogeneity in the ultra-centrifuge and in the electrophoresis cell and constant solubility. The solubility method is based on the phase rule which states that the solubility of a pure substance must be constant and independent of the amount of solid present in the system. This method is quite analogous to the classical melting point test for purity used in organic chemistry but which is not applicable to proteins. Very few proteins have been shown to be pure by all three tests. Crystalline pepsin prepared by the method originally described shows only one protein component when analyzed in the ultra-centrifuge or in the electrophoresis cell. The solubility of such preparations, however, usually varies with the amount of solid protein present, indicating the presence of more than one component. These preparations may be separated by fractional precipitation into at least two proteins of slightly different solubility and enzymatic activity. A method has been worked out for the isolation and crystallization of the more soluble of these proteins. Such preparations of crystalline pepsin have constant enzymatic activity and their solubility in several solvents is independent of the amount of solid phase present.

A simplified procedure for isolating the polysaccharides and nucleic acid of tuberculin using electrophoresis: **Florence B. Seibert** and **Dennis W. Watson** (introduced by D. H. Tennent). A simple scheme was devised for making a rough separation of the protein, nucleic acid and polysaccharide fractions of tuberculin. The protein was precipitated from the heated culture filtrate of tubercle bacilli, grown upon synthetic medium, by half saturation with ammonium sulfate at pH- 7.0 and 5° C. On standing in the cold the filtrate deposited a sediment, designated S2. The filtrate was carefully adjusted to pH- 4.0 with hydrochloric acid, yielding a flocculent precipitate, designated S3. Alcohol (95 per cent.) was then added to the filtrate until a brown sticky mass appeared at the interface between the two liquids. This mass was further separated into two fractions; one designated S4, which was readily soluble in water, and another designated S5, which was much less soluble. To the filtrate from these, more alcohol was added to remove ammonium sulfate and the remaining solution was concentrated in vacuo to a syrup, dialyzed in an extra heavy membrane, and dried in the cryochem, yielding a product designated S6. Electrophoretic studies in the Tiselius apparatus showed that all six fractions consisted of varying proportions of nucleic acid, protein and polysaccharide, a variance which probably accounted for their different physical properties. Chemical analyses confirmed the conclusions. Two types of polysaccharides were isolated in a Tiselius macroelectrophoresis cell, as well as by chemical separations. One type, which predominated in the S6 fraction, was immobile, homogeneous, colorless and contained only about 0.2 per cent. nitrogen. The other polysaccharide had a low mobility and was present in much larger quantities in the S4 fraction; its nitrogenous content, consisting of protein and nucleic acid, could never be reduced to less than 1.6 per cent. nitrogen, even by prolonged electrophoresis. Moreover, the component always remained diffuse, indicating that it is probably not a true compound. Pure nucleic acid was also isolated in the macroelectrophoresis cell.

Concerning the internal organization of the streptococcal cell: **Stuart Mudd** (introduced by O. T. Avery). New insight is being gained into the structure of the bacterial cell through the use of the new electron microscopes available at the RCA Laboratories. The chain structure of the hemolytic streptococcus, for instance, is seen to be due to the continuity from cell to cell of a solid surface membrane which is differentiated from an interior protoplasm. Cytolysis, as, for instance, under the action of sonic vibration, may cause this inner protoplasm to escape, leaving an empty membrane analogous to the stroma of a hemolyzed red cell (Mudd and Lackman). A single strain of Streptococcus pyogenes may occur in forms varying from the virulent mucoid variant with its extracellular envelope, to the naked pleomorphic cell of the rough variant, which is only just recognizable as a streptococcus. Chemically the streptococcal cell has been shown by Sevag, Smolens and Lackman to be about 80 per cent. protein and nucleoprotein. From 18 to 24 per cent. of the dry weight of mucoid and smooth variants is nucleic acid, and from 14 to 17 per cent. of the rough variants; of the nucleic acid 10 to 30 per cent. gives the color reactions characteristic of the desoxyribose type and the remainder the reactions characteristic of the d-ribose type. In higher animals and plants the desoxyribose type of nucleic acid is characteristically found in the nucleus and the d-ribose type in the cytoplasm—yet no indication of the existence of a nucleus within the streptococcal cell has been found nor has any phenomenon resembling karyokinesis been observed in this or other pathogenic bacterium. The nutritional requirements of the streptococcus are extremely exacting. Thus Pappenheimer and Hottle in this laboratory have found that a certain strain of streptococcus requires, besides a source of carbon and necessary minerals, several particular amino acids, and the six characterized members of the vitamin B complex—*thiamin, riboflavine, pyridoxine, pantothenic acid, nicotinic acid* and *biotin*. The metabolic potentialities of the streptococcal cell are equally complex. For instance, beside the protein, nucleic acid, carbohydrate and lipoid of its own protoplasm, the streptococcal cell has been shown to elaborate the erythrogenic toxin, a protein hemolysin, a fibrinolysin, a leucocidin and a newly detected lethal substance (Harris). The nature of the organization within a cell of only about 1 μ diameter, which makes possible such complex syntheses and transformations of matter, is not even definitely suggested by present-day knowledge.

The relation of hereditary constitution, allergic irritability, antibody production and the development of local immunity in resistance to tuberculosis: MAX B. LURIE (introduced by E. L. Opie). By brother and sister inbreeding of rabbit groups, under strictly similar environmental conditions, six families have been obtained in which the genetic constitution alone determines a characteristic inherited resistance to tuberculosis of each family, generation after inbred generation. Two of those families are highly susceptible to the disease. One is of exceptionally high resistance to the infection and three are intermediate in their susceptibility to tuberculosis. The fundamental variant in the disease developed by these three family groups is the degree to which the infection is limited to the portal of entry of the bacillus. In tuberculosis naturally acquired by respiratory contagion, the most resistant family confines the disease to the lungs where the infection originates and where it slowly progresses. There is little if any dissemination to the rest of the body. In the most susceptible families there is a rapid spread by the lymph and blood from the fulminating primary pulmonary lesion. The families of intermediate resistance exhibit an intermediate degree of generalization of the disease. This suggests that resistance to tuberculosis is largely a function of those constitutional factors which determines the host-parasite relationship at the portal of entry. When members of these three family groups were treated with heat-killed tubercle bacilli intracutaneously it was found that the most resistant family rapidly developed a high degree of tuberculin sensitivity, which was maintained at a high level. Likewise antibodies (agglutinins) against the tubercle bacillus soon appeared in the blood and attained a considerable concentration therein. The most typical and constantly susceptible family developed allergic sensitivity very slowly. Similarly in this family, antibodies appeared in the blood later and attained a concentration considerably below that of the resistant family. The families of intermediate resistance developed tuberculin sensitivity even more rapidly than the resistant one. However, the momentum of this increment soon abated and sank below that of the resistant rabbits. The antibody production of these families was intermediate in rate and intensity between those of the most susceptible and most resistant families. If rabbits thus treated with killed tubercle bacilli are now infected with virulent living microorganisms in the skin the most resistant family develops a lesion which rapidly attains a maximum and soon heals. It quickly develops a *local immunity*. The mononuclear phagocytes rapidly acquire an effective capacity to inhibit the growth of the bacillus in their cytoplasm, for bacilli are rarely found in them. In the most susceptible families the local lesion develops apace with but retarded and feeble healing. The phagocytes do not acquire sufficient power to inhibit the growth of the bacilli. Their cytoplasm swarms with them. An intermediate degree of local immunity developed in the rabbit families of intermediate resistance.

Studies on air-borne infection: WILLIAM FIRTH WELLS (introduced by E. B. Wilson). An apparatus for study of the bacterial behavior of air has revealed a mechanism of air-borne infection leading to a hypothesis that the semi-enclosed atmospheres of our habitations provide a vehicle for the epidemic spread of contagion. *Air as a vehicle of contagion:* Evaporation of minute droplets expelled in expiratory processes enables infection to ride these droplet nuclei on air-currents. Quantitative experiments upon animals, inhaling nuclei-infected air, demonstrate the penetration of these nuclei to the depths of the lung with consequent production of disease. The transfer of nuclei infection from infector to infectee depends upon conditions of sanitary ventilation, and the equilibrium concentration predicted by the ratio of elimination to addition rate of test organisms in semi-enclosed spaces corresponds to the concentration of nasopharyngeal organisms determined by sanitary air analysis. Aggregation within the same enclosed atmosphere implies the proximity in time and space which dominates the idea of contagion, and is implied by the term "contacts." Air-borne infections thus become contagious infections. *Dynamics of epidemic contagion spread:* Contagious epidemics are characteristically dynamic, waxing or waning with infection velocity depending upon atmospheric density of susceptibles. If susceptible density depends upon immunity conferred by infection, then the magnitude of an epidemic will be double the initial excess density of susceptibles over the "threshold density" determined by critical sanitary ventilation. *Experimentum crucis:* Bactericidal irradiation of air provides an instrument for making the experimentum crucis, *i.e.,* the effect of air disinfection upon the incidence of contagion introduced into susceptible aggregations, first to determine whether the epidemic spread of childhood contagions through aggregations of susceptible children can be prevented by raising the sanitary ventilation above a critical value. For three successive years classes in irradiated rooms of the primary department of the Germantown Friends School have been spared the epidemic spread of mumps or chicken-pox suffered by comparable classes in unirradiated rooms in each of these years. *Conclusion:* We intend to pursue the theory to scientific proof but believe that enough is now known to warrant the recommendation that ultraviolet radiation apparatus be installed in buildings designed to house large companies of men.

Fat metabolism in diabetes mellitus: William C. Stadie, John A. Zapp, Jr., and F. D. W. Lukens (introduced by D. D. Van Slyke). The current theories of fat metabolism in diabetes mellitus are: 1. Knoop's hypothesis of successive beta oxidation. 2. Hypothesis of obligatory coupled ketone body-carbohydrate oxidation. (3) Fatty acids are converted by the liver into carbohydrate. Evidence in the literature and our own experiments convince us that these hypotheses are no longer tenable. That ketone bodies are utilized by the peripheral tissue of the diabetic animal was shown by four independent methods in the depancreatized cat. Therefore the depancreatized cat must oxidize ketone bodies without coupling with carbohydrate oxidation. The multiple alternate oxidation hypothesis postulates that fatty acids are simultaneously oxidized along the entire length of the chain at alternate carbon atoms with the formation of four molecules of ketone bodies per molecule of fatty acid and no acetic acid. Further experiments conformed to the hypothesis of multiple alternate oxidation rather than the Knoop hypothesis. By means of the multiple alternate oxidation hypothesis the ketone utilization in human cases of diabetes was calculated. The calculations show an abundant utilization of ketone bodies independent of carbohydrate oxidation. A new hypothesis for the metabolism of fats in the diabetic was formulated: Up to a certain level of fat catabolism (about 2.5 gm. of fat per Kg per day) fats are utilized completely and there is no ketonuria. When total fat catabolism exceeds this amount only a part of the fat is completely oxidized. The balance is excreted as ketone bodies. There is no obligatory chemical coupling of fat and carbohydrate oxidation. In further experiments with liver slices from depancreatized cat the important oxidative reactions were measured. The results show that there was no oxygen available for the conversion of fat to carbohydrate. It was concluded that the overproduction by the liver of carbohydrate from fat does not occur.

Qualitative differences in the biological activity of adrenal cortical steroids: Dwight J. Ingle (introduced by A. N. Richards). Extracts of the adrenal cortex have a number of measurable physiologic properties. They are capable of maintaining life in adrenalectomized animals, effect the distribution of electrolytes in the body, the amounts of carbohydrates in the body; they will maintain the ability of the adrenalectomized animal to work, and when administered in large amounts to normal animals will cause the atrophy of the adrenal cortices. A large number of pure compounds have been isolated from extracts of the adrenal cortex. Some of these compounds are biologically inactive and the active compounds show qualitative differences in their biologic properties. Thus it is found that those compounds which are the most active in prolonging the life of adrenalectomized animals are incapable of maintaining normal carbohydrate metabolism. On the other hand, compounds which have the greatest effect upon the carbohydrate metabolism of normal or of adrenalectomized animals are only weakly active for maintaining life and in effecting the distribution of electrolytes.

(*To be continued*)

REPORTS

A NEW PAN AMERICAN TREATY

"Washington, October 12—American Republics Sign Convention on Nature Protection." Such was the heading of a news release sent out by the Pan American Union. This was the announcement of the inception of an International Nature Protection Treaty designed to meet the international wildlife problems of the twenty-one American Republics. This is the first treaty of its kind ever to be proposed on this continent. It is planned to include twice as many countries as the only other International Convention of a similar nature. I refer to the London-African Convention of 1933, which included no provisions for migratory bird protection.

This Pan American Convention marks the third great cooperative step taken by the United States to further wildlife protection by international treaty on the American Continent.

In 1916 we ratified the Migratory Bird Treaty with Great Britain with respect to Canada. This treaty became effective in 1918. In 1936 we ratified a somewhat similar treaty with Mexico. In addition to these treaties we have entered into international agreements regarding seals, whaling, and fisheries. The Pan American Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere covers a broad virgin field for international agreement.

It establishes a basic pattern for a scheme of parks and reserves throughout the Americas which our own experience has taught us is thoroughly sound. It provides for appropriate protective laws for flora and fauna where inadequate ones exist. It favors cooperation in scientific field studies, the protection of migratory birds, the protection of vanishing species listed in a special annex, and the control of contraband fauna or flora protected by the laws of another country.

The following are the definitions of four categories of parks and reserves under the terms of the convention:

1. The expression *National Parks* shall denote:

Areas established for the protection and preservation of superlative scenery, flora and fauna of national significance which the general public may enjoy and from which it may benefit when placed under public control.

2. The expression *National Reserves* shall denote:

Regions established for conservation and utilization of natural resources under government control, on which protection of animal and plant life will be afforded in so far as this may be consistent with the primary purposes of such reserves.

3. The expression *Nature Monuments* shall denote:

Regions, objects or living species of flora or fauna of esthetic, historic or scientific interest to which strict protection is given. The purpose of nature monuments is the protection of a specific object, or a species of flora and fauna, by setting aside an area, an object or a single species, as an inviolate nature monument, except for duly authorized scientific investigations or government inspection.

4. The expression *Strict Wilderness Reserves* shall denote:

A region under public control characterized by primitive conditions of flora, fauna, transportation and habitation wherein there is no provision for the passage of motorized transportation and all commercial developments are excluded.

There follow several articles dealing with the establishment of these parks and reserves.

The brief history of this convention takes us back to Resolution XXXVIII of the Eighth International Conference of American States, at Lima, Peru, in December, 1938, which provides for the establishment by the Pan American Union of a Committee of Experts, to study the problems of nature protection and wildlife preservation in the American Republics, and to formulate a Draft Convention for the preservation of the flora and fauna in the Western Hemisphere.

The Governing Board of the Pan American Union, in accordance with this resolution, called a meeting of the Committee of Experts for May, 1940, in the city of Washington.

The following countries were represented on this committee: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, the Dominican Republic, Ecuador, Haiti, Mexico, Panama, Paraguay, Peru, the United States, Uruguay and Venezuela.

The committee held meetings from May 13 to 16 inclusive, at which it carefully considered material assembled in answer to a questionnaire sent out by the Pan American Union, and in accordance with this and with other information available prepared a draft of a convention which covers the important basic requirements for nature protection and wildlife preservation on a broad international basis for the American Republics. The draft of this convention received the unanimous approval of the above-mentioned committee of experts.

On October 12, the day on which the convention was opened for signature at the Pan American Union, representatives of the following countries affixed their signatures: Cuba, Ecuador, El Salvador, the United States, Nicaragua, Peru, the Dominican Republic and Venezuela. Other countries have signified their intention of signing in the near future.

Science, art and literature have forged strong ties between the American Republics. This convention should add still another tie through its parks, reserves and monuments, which will help to bring about a common interest in great masterpieces of creation in the Americas.

The signing of the convention was hailed by the Minister of El Salvador, Dr. Hector David Castro, in the following words:

> In affixing their signatures to the Convention on Nature Protection and Wildlife Preservation in the American Republics, the representatives of the nations of the Western Hemisphere have to-day pledged their countries to adopt measures for the protection of useful, harmless and ornamental species of plant and animal life. They have thus given formal recognition of the fact that many such species know no national boundaries, and that true conservation of the gifts of nature should begin before these resources have been dissipated by thoughtless or selfish destruction.
>
> This action brings together and thus strengthens all the unselfish efforts of individuals and governments throughout the countries of the New World. I am highly gratified that in a world so occupied with questions of grave political and military consequence a body of independent nations thus voluntarily agree upon a program aimed only at the peaceful end of protecting the endowments of a bountiful nature.

The spiritual value of the "natural beauty" that we hope to preserve for future generations in these great New World Continents can be most perfectly described in the following words of G. M. Trevelyan:

> By the side of religion, by the side of science, by the side of poetry and art, stands natural beauty, not as a rival to these, but as the common inspirer and nourisher of them all, and with a secret of her own besides. . . . It alone makes a common appeal to the sectaries of all our

religious and scientific creeds, to the lovers of all our different schools of poetry and art, ancient and modern, and to many more besides these. It is the highest common denominator in the spiritual life of to-day.

Let us hope that all the American Republics will sign, ratify and pass enabling laws to get the greatest benefit from this International Convention as soon as possible. We also hope that our Government, which stands first in conservation measures in the Americas, will lead the way by being the first to ratify.

HAROLD J. COOLIDGE, JR.,
Chairman, Pan American Committee of the American Committee for International Wildlife Protection
MUSEUM OF COMPARATIVE ZOOLOGY,
CAMBRIDGE, MASSACHUSETTS

SPECIAL ARTICLES

UPTAKE OF RADIOACTIVE PHOSPHORUS BY NUCLEI OF LIVER AND TUMORS

MICE carrying 10- to 15-day lymphoma[1] transplants were given 0.1 cc of isotonic Na_2HPO_4 containing 6–10 microcuries of P_{32} by intravenous injection. At intervals afterwards the livers were cleared of blood by perfusion with saline, immersed in ice cold 5 per cent. citric acid for one-half hour, and the nuclei isolated by centrifugation of the pulped tissues. Tumors were removed from the same animals and similarly treated to obtain nuclei. Haemacytometer counts were made on all samples of nuclei, and contamination by fragments of cytoplasm was found to be negligible.

Fig. 1 shows the microcuries of P_{32} per cm^3 packed nuclei as a fraction of the P_{32} activity per gram wet weight of whole tissue plotted against time after injection. Whereas the fraction of the liver P_{32} bound by the nuclei remains constantly at .3–.4, the relative concentration in the tumor nuclei rises to more than twice that of the tumor tissue. Similar results have been obtained with sarcoma 180 in the mouse.

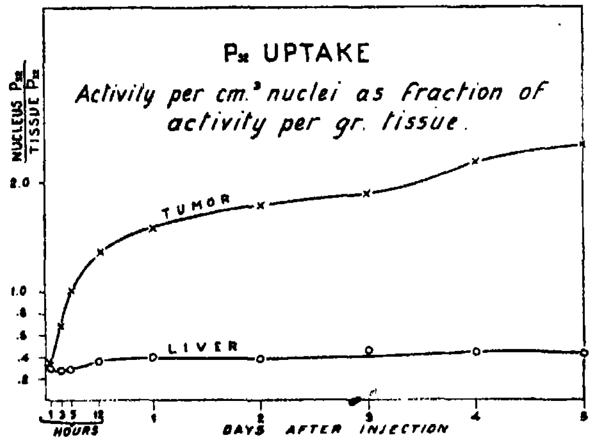

FIG. 1.

Isolated nuclei suspended in isotonic Na_2HPO_4 containing P_{32} take up only one tenth the *in vivo* nuclear activity, and most of the *in vitro* activity can be shown to be adsorbed phosphate. Nuclei from liver slices shaken at room temperature in isotonic Na_2HPO_4 have less than one hundredth of the *in vivo* concentration of P_{32}. The uptake of P_{32} can not therefore be attributed to simple chemical exchange.

After extraction with alcohol-ether and trichloracetic acid 60 to 70 per cent. of the P_{32} of the liver nuclei is in the residue (nucleoprotein) and 70 to 95 per cent. of the P_{32} of the tumor nuclei is in the same fraction at all intervals from one hour to five days after injection.[2] The data indicate that P_{32} may be built into the nucleoprotein directly from the inorganic phosphate or that the rate of turnover in the more labile forms of organic phosphate is very rapid. Since the metabolic rate is lower in the rat than in the mouse, it is expected on the latter hypothesis that for comparable tissues (*e.g.*, liver) the relative P_{32} concentration in the nuclei of the rat will be lower than for the mouse. From one-half hour to two days after injection of P_{32} into 150-gram rats, the concentration in the liver nuclei is approximately 0.1 per cent. of the injected dose. The second alternative, therefore, seems the more probable.

To determine whether the greater concentration of P_{32} by tumor nuclei is characteristic of the tumor *per se* or is to be attributed to mitotic activity, three 150-gram rats were partially hepatectomized and given P_{32} intravenously 36 hours later. Three normal rats of the same weight, and three rats carrying bilateral carcinoma 256 implants were injected at the same time. Two days later livers and tumors were removed. The ratios of nuclear P_{32} to tissue P_{32} were .345, 1.02 and 1.08 for nuclei from normal liver, regenerating liver and tumor, respectively. With rats injected four days after partial hepatectomy and nuclei removed three days after P_{32} injection, the ratios for nuclei from normal and hepatectomized animals were .28 and .32, respectively. Very few of these nuclei were found in mitosis, while of the liver nuclei removed in the first experiment 3.7 per cent. were in anaphase or metaphase and a much larger per cent. in prophase. The greater P_{32} uptake by tumor nuclei should therefore be attributed to mitotic activity.

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[1] J. H. Lawrence and Gardner, *Am. Jour. Cancer*, 33: 112–119, 1938.

[2] The data are insufficient as yet for determining whether the difference in nucleoprotein P_{32} of tumor and liver nuclei is significant. (71, 67, 64, 68, 53, 72 per cent. in liver nuclei at one hour, 1, 2, 3, 4, 7 days after injection and 98, 95, 94, 70 per cent. in lymphoma nuclei at 1, 3, 5, 7 days.) Preliminary data show no difference in nucleoprotein P_{32} of rat liver and carcinoma nuclei.

There are 14.8×10^{-10} mg P/liver nucleus and 12.8×10^{-10} mg P/tumor nucleus. From the nuclear phosphorus composition and the nuclear P_{32} content at 48 hours, the specific activity of tumor nuclei is found to be more than four times that of liver nuclei. Calculating from the daily P_{31} retention[3] and the per cent. P_{32} uptake, each nucleus will incorporate a quantity of P_{31} equal to 8.9 per cent. of its P_{31} content in five hours. It will thus take 56 hours for the nucleus to synthesize a quantity of P_{31} equal to the amount it originally contained. This should be the time required to synthesize a new nucleus. This value agrees approximately with the observed rate of growth of the tumor which doubles in size in about two days at this phase of its growth curve.[4] It is interesting, though it may be purely a coincidence, that approximately the same time is obtained for the duration of the mitotic cycle in root tips by analysis of effects of x-rays and neutrons.[5]

A detailed account of these experiments will be presented elsewhere.

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[3] L. W. Tuttle, personal communication.

[4] Growth curves obtained from I. L. Chaikoff and H. B. Jones, unpublished.

[5] A. Marshak, *Proc. Nat. Acad. Sci.*, 25: 502–510, 1939.

[6] Fellow of the John Simon Guggenheim Memorial Foundation.

MODE OF ACTION OF ESTROGENS ON THE MAMMARY GLAND

Following the demonstration by Lyons and Pencharz[1] in 1936 of the failure of estrogenic hormone to produce growth of the mammary glands of hypophysectomized guinea pigs, a sizable literature has appeared in confirmation of this work, which has been extended to include the rat, mouse, cat, rabbit and ground squirrel.[2] These observations emphasized the importance of the pituitary to the mammary gland and gave rise to the theory that injected estrogens exert their effects through the mediation of the pituitary, which was postulated to produce a specific mammogenic hormone.[3]

The specificity of the relationship between the pituitary and mammary growth has, however, been called into serious question by the demonstration[4] that in intact rats which were restricted to a diet comparable to that consumed by hypophysectomized litter-mates, the glands likewise failed to respond to administered estrogen. It has been shown,[5] further, that when hypophysectomized rats were treated with growth complex, growth of the mammary gland could be elicited by estradiol benzoate, and that the degree of stimulation could be correlated with the weight gain of the animals.

Recent experiments permit of a new approach to the problem of the mode of action of estrogenic substances on the mammary gland. By the direct application of the hormone to the nipple area it is possible to obtain a local effect on the nipple and mammary gland. In this manner one can observe the effects of the test substance in the intact animal, thereby obviating the complication of nutritional disturbances produced by hypophysectomy.

Immature male rhesus monkeys were used. The left nipple of each animal was painted daily with a solution of estrone in 95 per cent. alcohol, 0.05 mgm per cc. To the right nipple alcohol alone was similarly applied. Two animals were so treated for a period of 75 days. The entire glands were then removed. A third animal was treated in this manner for 50 days, and the breasts were removed 105 days later. The mammary glands were then fixed, dissected, stained and cleared, and studied as whole mounts.

In all cases the left mammary gland was distinctly larger and more developed than the right one (see Fig. 1). This difference in size exceeded, in each instance, the minor variations between right and left glands occasionally encountered in a study of more than 200 pairs of control monkey mammaries, including the breasts of 30 males.

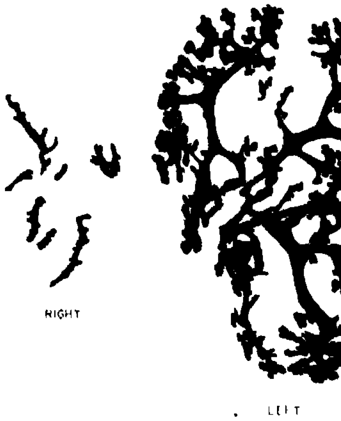

Fig. 1. Right and left mammary glands of prepubertal male monkey after daily application of alcoholic solution of estrone to left nipple for 75 days. Silhouette tracings from photographs of actual specimens.

These observations are regarded as evidence for the direct action of percutaneously administered estrogen on the mammary gland. While not controverting the possible existence of pituitary mammogenic hormones, or even the possibility of estrogenic stimulation of the production of mammogenic hormones by the pituitary, the present experiments offer no support for the view that administered estrogens necessarily stimulate mammary growth through the mediation of the pituitary. For if such were the case, a similar growth response would be expected in both glands, rather than the local, unilateral effect observed.

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[1] W. R. Lyons and R. I. Pencharz, *Proc. Soc. Exp. Biol. and Med.*, 33: 589, 1936.

[2] E. T. Gomez and C. W. Turner, *Mo. Agr. Exp. Sta. Res. Bul.* 259, 1937.

[3] A. A. Lewis and C. W. Turner, *Mo. Agr. Exp. Sta. Res. Bul.* 310, 1939.

[4] E. B. Astwood, C. F. Geschickter and E. O. Rausch, *Am. Jour. Anat.*, 61: 373, 1937.

[5] I. T. Nathanson, D. T. Shaw and C. C. Franseen, *Proc. Soc. Exp. Biol. and Med.*, 42: 652, 1939.

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THE CONTROL OF PROTOPLASMIC STREAMING

PROTOPLASMIC streaming owes its existence to a motive force the magnitude of which has heretofore not been measured. In order that this might be done the technique here described has been developed.

The slime mold, *Physarum polycephalum,* served as material. Protoplasmic streaming in slime molds is extraordinarily active and exhibits a rhythmic reversal in direction of flow.

Small bits of plasmodia placed on cover-glasses coated with agar soon spread into thin sheets, which later develop protoplasmic strands. Among such cultures there are forms which can be changed so that there are two protoplasmic bodies connected by a single strand. A plasmodium thus shaped is inverted over a chamber which is divided into two compartments (A and B, Fig. 1) by an agar block (C, Fig. 1).

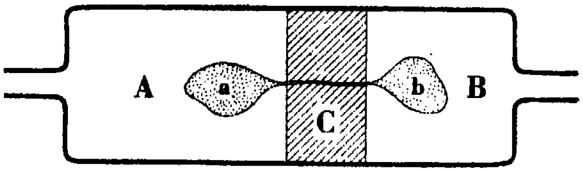

FIG. 1. Schematic representation of the chamber.

The construction is such that the two compartments may be kept airtight without the wall separating them blocking protoplasmic flow in the connecting strand. One of the two compartments is kept at constant atmospheric pressure, whereas the pressure in the other compartment is under control.

When there is no pressure difference between the two compartments, the shuttle movement of the protoplasm goes on normally, causing a corresponding change in the volume of the two protoplasmic masses (A and B, Fig. 1). When, however, a difference in air pressure is established between the two compartments, the movement of the protoplasm in the connecting strand is strikingly affected. If a slightly lower pressure (weak vacuum) is applied to one of the compartments, the flow of the protoplasm in the connecting strand into that compartment is accelerated. When a slightly higher pressure is applied to the same compartment, the flow of the protoplasm along the connecting strand into that compartment is retarded. If the pressure applied is stronger than the motive force developed in the plasmodium, then the forward-moving protoplasm is forced backwards. The direction and velocity of the protoplasmic movement in the connecting strand can thus be accurately controlled. Artificial control of protoplasmic streaming in this manner does not cause any observable damage. Flow continues normally after the applied pressure is released.

By this method it is possible to ascertain the precise degree of pressure necessary to hold the protoplasm at a standstill. The pressure at this point, which is regarded as equal in absolute value to the motive force responsible for the protoplasmic streaming, may be termed the balance-pressure. The range of the balance-pressure is usually between ± 20 cm of water. The maximum absolute value thus far encountered is 28 cm of water. So sensitive is the movement of the protoplasm that the slightest deviation (less than 0.2 cm of water) from the point of balance-pressure will induce movement in an 8 mm connecting strand.

As the motive force changes spontaneously, the balance-pressure must be adjusted accordingly, if the protoplasm is to be kept immobile. In order to determine in what manner and to what extent the motive force changes in relation to time, the instantaneous values of the balance-pressures (*i.e.*, the values taken at any given instant) are recorded at five-second intervals. By plotting a series of these values as ordinates against time as abscissas, undulating curves are obtained which faithfully portray the distinguishing features of the changes which the motive force undergoes during the rhythmic succession of vital processes. The graphs thus obtained give a complete view of the rhythm in protoplasmic activity. All characteristics of rhythm such as wave form, frequency, polarity and amplitude are portrayed by the graphical representation.

The study of many examples of wave trains mapped in this way leads to the conclusion that the characteristic change in amplitude and in form of wave is, in all probability, due to the interference of different rhythms. This concept necessarily implies the co-existence, in one and the same plasmodium, of different frequencies of the mechanism responsible for the motive force. In other words, a plasmodium is a polyrhythmic system.

In this brief note I am not in a position to go into further details of description and discussion of my experiments, except to say that in addition to an analysis of protoplasmic rhythm the method here touched upon is a means for attacking such problems as that of the relative influence of motive force and viscosity in protoplasmic flow. The procedure outlined above also suggests a new method for measuring protoplasmic viscosity by applying the principle of the capillary viscometer which so far has been used only for non-living substances.

My special appreciation is due to Professor William Seifriz for his unfailing interest and critical supervision. This investigation was aided by a grant from Mrs. Curtin Winsor, to whom I wish to express my most sincere thanks.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE METHOD OF MOUNTING SMALL EXHIBIT SPECIMENS OF MAMMALS AND BIRDS

AT regular intervals most scientists are confronted with the problem of presenting their work graphically to boards, patrons or laity. Biologists and medical researchers frequently must prepare taxidermic specimens used in their studies for such exhibits or for permanent museum record. Because an expense account seldom envisages the preparation of these demonstrations, professional assistance can not be readily procured.

It is for the above reasons that I believe my simple method of mounting small mammals is worth placing on record. This technique was first applied to mouse specimens exhibited at the Harvard Tercentenary in 1936, and more recently it has been employed on rats for the museum collections of the Wistar Institute, where they will be pointed out upon request. There is no reason why this method can not be readily extended with modifications to small birds and mammals generally.

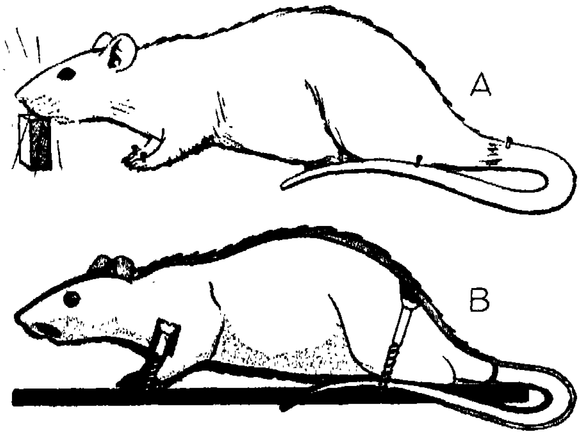
For the sake of simplicity I shall here describe the method as applied to the rat. First, kill the rat with a lethal dose of ether, chloroform or by some other method that will not harm the anatomy.

Inject 10 cc of 40 per cent. formaldehyde into the thoracic cavity and another 10 cc into the abdominal cavity, massaging the animal to distribute the injection fluid within the body cavities. Inject small amounts into the legs and subcutaneously over the body.

Within 15 minutes to half an hour subsequent to this injection the body will stiffen. When fairly rigid, place the rat upon a small temporary base-block of wood in the position desired for the finished specimen. Brad the rat's tail to the block. Then brad the four feet to their proper positions bending the body into the pose desired. The hips may be prevented from moving laterally by hammering several 7-penny nails into the block adjacent to the hips. The head may be held up by resting the teeth on a block of proper dimensions. See Fig. A.

When the animal is in the position desired, allow it to stand an hour or so until it has completely hardened.

Invert the specimen and wash it thoroughly under a faucet so water will wet the whole outer surface of the skin. Place the inverted specimen, block and all, into a jar of formalin and allow it to stand 24 hours. The previous washing removes all air caught in the fur that might prevent areas of the skin from coming in contact with formalin.



FIGS. A and B.

After the specimen has cured 24 hours in formalin, wash under the faucet for a few minutes to remove all traces of formalin, which will attack the skin of the operator's hands, unless they are otherwise protected.

Lay the specimen on its back, and with a sharp razor blade cut the skin along the mid-ventral line from throat to genitals. Cross-slit between the two wrists and also between the two ankles. Now skin the animal. Wash from time to time to remove formalin from the interior. Sever the feet, leaving them attached to the skin of the legs. By first rolling the tail vigorously, the skin of this appendage may be readily slipped off. If difficulty is here encountered, a slit may be made along the ventral surface of the tail.

The detached skin, which tends to retain the shape of the posed specimen, is put back into the jar of formalin to harden further.

The body is then placed in its normal position in a small box to support the body mold which is cast from hide glue, plaster or a recently patented substance known as Plastico which has an agar base. When the mold has hardened, slit it longitudinally and remove the body. Cast a duplicate body in the mold with plaster or wax, preferably the former. Any projections produced in casting the body may be cut away with a knife and any depressions that may occur can be filled with Plasticine. The tail skin may be filled with plaster, wax or fine lead shot. Arrange a permanent black wooden mounting and adjust two screws to run through the plaster body sagitally so as to hold the finished specimen in the position desired. See Fig. B.

Set artificial eyes (beads or glass pin heads) in their depressions on the head of the plaster body. Wash the skin in water. Dry it with paper towels. Slip the skin over the plaster body and sew up the one longitudinal and two cross-slits.

Brad the feet to their proper positions. In life such regions as ears, eyelids and toes are pink, due to the presence of subcutaneous blood vessel distribution. These areas may be tinted lightly with red ink mixed with water to produce the appropriate shade.

Adjust eyelids, nose, ears and feet from time to time until the finished specimen hardens.

Two great advantages of this method aside from its simplicity are, first, that each individual retains its individuality of form and, second, that each specimen may be caused to assume any one of a great variety of possible poses.

CLYDE E. KEELER

WISTAR INSTITUTE

A MICROPHOTOGRAPHIC CAMERA

IN the May 24 issue of SCIENCE[1] Abrahamson described "An Inexpensive Microphotographic Camera." For those interested in making an occasional photomicrograph a very simple method was described and illustrated by Turrell.[2]

The microscope is focused and a cheap vest pocket kodak, fitted with a yellow filter, is placed on the eyepiece, being kept in position by its own weight. Exposure is made with a cable release. If a focusing camera is used the focus should be set for infinity and the lens diaphragm should be wide open. When using a 10 × ocular, the image circle does not fill the entire negative area, but it can be enlarged.

CHARLES GOOSMANN

CINCINNATI

AUTOMATIC MERCURY VALVE

THIS simple valve arrangement will prevent the forcing or accidental spilling of mercury from an open tube, yet offers negligible resistance to the flow or oscillation of the mercury.

The stainless steel ball "B" and the constriction "A" (ground to a 45° angle) will form a valve that will stop the falling (Fig. 1) or rising (Fig. 2) mercury column "C" at "A."

With a valve (as shown in Fig. 1) located on the citrate side of a mercury manometer such as is used for direct blood pressure recording, it is impossible for excessive pressure to expel the mercury.

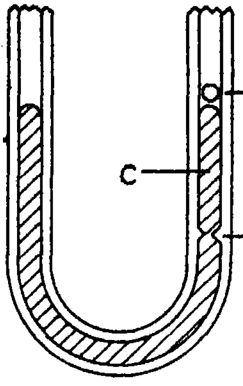
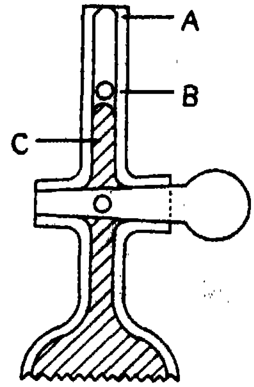


FIG. 1



opla FIG. 2

FIG. 1. Mercury ure. Th (Pyrex).
FIG. 2. Air samp ween ± 2 Pyrex).

Air sampling tubes equipped as in Fig. 2 will permit rapid positive evacuation without the usual overflow of mercury.

HUGH B. MCGLADE

THE OHIO STATE UNIVERSITY

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[1] SCIENCE, 91: 509, 1940.

[2] F. M. Turrell, Trans. Am. Micros. Soc., July, 1938, 267.

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THE EFFICIENT PARASITE[1]

By Dr. N. H. SWELLENGREBEL

PROFESSOR OF PARASITOLOGY, UNIVERSITY OF AMSTERDAM

THE paper I was supposed to read, but did not, in Section V of this congress bore the title, "The Efficient Parasite." I am going to tell you of a highly efficient parasite I came across in the bush-country of Dutch Guiana. But before coming to that, let me first explain to you what I understand by the word "parasite." Once I have made that clear, the other word, "efficient," will need no explanation.

Now, I beg of you, keep this in mind, that I am not going to tell you what a parasite is, but only what I understand this word to signify. It is simply a matter of definition. Many, or all, of you may have an entirely different definition in mind. So all I ask of you is to accept my definition just for argument's sake and for a period of forty minutes. By the end of that time you may reject it without giving it another thought.

Well, then, by parasite I understand an organism wholly dependent on another living organism for its food, its shelter and its reproduction. That other living organism, which provides the parasite with board and lodging, including sufficient shelter to carry on its love affairs without awkward disturbances of any kind, is usually called "the host." If the host is to be of any use to the parasite, it ought to be a living host; a dead host is no good. Now, please, keep that in mind: a dead host is not a host any longer. When the host dies, the whole brood of parasites inside or on his body dies with him. I need not give you any examples; you all have them at your fingers' ends.

Now I ought to admit at once that this statement is not always true. A very striking example is offered by the anthrax bacillus. That is an organism which actually thrives on the death of its host. In fact, it could not continue its existence without that death. It has to kill its victim, otherwise it itself will perish. To this I answer that the anthrax bacillus is not a parasite at all, because it is a free-living organism, staying in the soil for any number of years, the only peculiarity about it being its non-feeding and non-reproducing. Once in a while, maybe at intervals of many years, it indulges in an orgy of feeding and reproducing. In order to do so it needs a host, better call it a victim or a prey. For it is no more a host than the man who is devoured by a lion. The lion lives by the man's death. The anthrax bacillus lives by the cow's death. For if the cow does not die, but recovers, all the bacilli in its body are killed. But the cow's death stimulates the bacilli to produce spores, a thing they did not do when the cow was still alive. These spores, the free-living stage in the anthrax bacillus' life-cycle, enable it to continue to live in the soil, long after its victim's body has been turned into dust.—No, the anthrax bacillus is not a parasite at all, its victim is not its host, but its prey; this bacillus is a *predaceous organism*. There are many predaceous organisms amongst the bacteria, although not in such a striking fashion as the anthrax bacillus. In fact, it is my opinion that bacteria have done a god deal in the way of blurring our conception of what a parasite really is like.

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[1] Address delivered before the General Sessions of the Third International Congress for Microbiology, New York, September 2–9, 1939.

And, in case you think it is all nonsense that I am trying to make you swallow, let me tell you that this bright idea of mine is not mine at all, but that of your great countryman, Theobald Smith, who has invented the conception, and coined the name, of predaceous organisms, as distinct from true parasites.

So I repeat and maintain that the true parasite is dependent for its existence on the life of its host—more than that, on the well-being of its host. And the efficient parasite is the one which has succeeded in keeping well out of harm's way, harm to its host as well as to itself. The efficient parasite lives quietly in a secluded corner. It is frugal and modest in its feeding and in its reproduction. In short, the efficient parasite is a non-pathogenic organism. Such organisms have sometimes been given separate names: symbionts, if they were supposed to benefit the host; commensals, if they were supposed to do him neither harm nor good. All these names are quite superfluous; "efficient parasite" covers them all.

But are there inefficient parasites? Oh, yes, there are. Every efficient parasite may become an inefficient one, by change of surroundings. And the principal and most distressing sign of its inefficiency (both to itself and to its host) is its pathogenicity. I know it will be rather hard for the medical profession to admit this. But if one reflects that, as a broad rule, nobody thinks of looking for parasites in man, unless there is some incentive to take that trouble, *i.e.*, unless some state of ill health does exist, it is not to be wondered at that the conception of "presence of parasites" and the conception of "disease" are inextricably mixed up. So much so, indeed, that the word "infection" (which really means nothing but the presence of parasites in the host's body) is used as a synonym of "disease." The expression "he is suffering from a malarial infection" may either mean that he is suffering from a fever, or that he is simply showing parasites in his blood, the suffering being usually taken on trust.

That is the reason why parasites, as far as human parasites go, are best known in their inefficient state of pathogenicity. It is different in animals, but the study of parasites in animals offers the disadvantage that we are often unable to decide whether the parasite is doing any harm or not. It is impossible to determine the general mortality, the infant mortality, the natality and other vital statistics in a natural population of earthworms or centipedes.

But to return to the efficient and inefficient parasites. There are parasites which are always (or nearly always) efficient, always harmless, like that dweller of our intestinal tract, *Entamoeba coli*. Whether or not there exist true parasites which have found it possible to carry on hampered by an ineradicable habit of killing their host I do not know and am inclined to doubt. But there can be no doubt that there exist parasites which are so pathogenic that they can only save the existence of their species by some contrivance which constantly enables them to jump from one dying victim to a still healthy one, each time, of course, at the loss of thousands of unfortunate individuals which did not succeed in effecting this transition. But even among these apparent incurables, one sometimes comes across specimens which frankly show for once their true parasitic (*i.e.*, non-pathogenic) nature.

I want to tell you of such a find.

Imagine for a moment a medical man, practicing in a malarious area and invariably in the habit of taking bloodslides of all his fever-patients. (In my country such a practitioner is far from common, but that, no doubt, is different here.) You will agree that such a man will be apt to associate any morbid symptoms he detects in his patients with the parasites he finds in their blood. And, as a rule, he will be proved in the right, by the symptoms disappearing in the course of an anti-malarial treatment. Of course I realize that this, sometimes, is a proof of very doubtful value, but let us leave it at that. But this year I visited a country where the otherwise highly laudable practice of making a bloodslide of every patient would lead to the most complete and hopeless confusion and ill-treatment.

But allow me to relate my experience in the proper order of events. Just as an introduction, let me tell you that I stayed in Dutch Guiana for four months in order to study the sanitary possibilities for the settlement of Jews in that part of the wet tropics. I soon realized that a proper selection of the site for a prospective settlement would have to take account of malaria as one of the major health problems. I do not want to bother you with the various problems I had to face. Sufficient to say that the study of one of these problems carried me to the densely wooded interior of Dutch Guiana. This interior is not inhabited by European or by the colored agricultural population living in the area nearer the coast. There exist no roads leading to those districts and the rivers, which in the coastal country are the great arteries of traffic, are of no use as a means of transport, since they can not be navigated by any craft except the small native boats or *coryals*, owing to the numerous rapids. In these remote areas a purely African population is living, supposed to have been descended from runaway slaves who settled there in the course of the eighteenth century. They are known as bush Negroes. They are entirely different from the Negro population living in the coastal districts. Except on formal occasion they go almost naked, their houses are different, their language is different. Still they are not quite unaffected by European influence, since the Moravian Brothers and the Roman Catholic Church have established a few mission stations along the upper reaches of the Surinam River. Although these missionary efforts have but little influenced their mode of life, they have, in one village at least, which has been completely Christianized, brought about a very accurate registration of the total population, which has been continued for many years. Every individual is registered at birth, again at the time of christening, of marriage and of death. Since there exists little or no intercourse with the outer world, and since the preachers and schoolmasters living among them know every inhabitant by name, this registration of births and deaths may be regarded as fairly reliable, much more reliable than any data I have been able to collect in other parts of the world under more or less similar circumstances.

The areas inhabited by bush Negroes are all known as highly malarious. Malaria exists extensively in Dutch Guiana, along the coast as well as in the interior. But whereas sub-tertian is comparatively rare in the former districts, it is the predominant type of malaria in the bush, often associated with black-water fever. The reason why the unhealthiness of the bush area has become a byword in the colony is not that the bush Negroes themselves are known to suffer severely. The people who suffer are those habitually living in the coastal districts and who penetrate into the interior for the sake of collecting wood, balata or gold. That is the reason why the localities known to be most unhealthy are invariably those where strangers to the bush country assemble in the largest numbers. It is always cases of malaria among police constables, district commissioners and their staff, balata-bleeders or gold-washers, that come to our notice. The bush Negro looms largely in the background, but he is never mentioned specifically. The bush Negro is supposed to be immune to malaria and, according to classical conceptions, to have acquired this immunity by heavy and prolonged attacks from which he suffered in his infancy and to which many of his less fortunate brothers have succumbed; *an immunity gained at the price of a* heavy mortality, especially infant mortality.

The village to which my attention was directed by the existence of a registration coming as near to vital statistics as could ever be expected in these wild surroundings, did not suffer from such a bad reputation for the simple reason that there were not sufficient strangers to give the place a bad name. Still it richly deserved that name, for all missionary servants who had not previously lived in a malarious area came down with fever after a period of residence ranging from half a month to three months. My own experience corroborates theirs. I had falciparum malaria eleven days after stopping quinine prophylaxis which I had practiced during my stay in the bush.

Among the bush Negroes themselves, malarial fever was of comparatively rare occurrence. During our ten days' stay in the village my assistant, Dr. van der Kuyp, treated nearly 600 people, two thirds of the whole population, which numbers about 900. Out of these, fourteen were treated for malarial complaints, *i.e.*, a little over 2 per cent. of the total number of patients. You will realize how small that number is, when I tell you that it equals the percentage of cases treated for malaria among the patients in that particular district of the coastal area we have selected as the most appropriate spot for Jewish immigration, since the spleenrate among school children hardly exceeds 10 per cent. So, according to that ten days' medical treatment of the greater part of the bush Negro population of that particular village, malaria was of very little importance.

Malariometric examination of about half of the population had an entirely different tale to tell. I feel I must apologize that I did not examine more in this ideal field of research. But when it came to taking bloodslides of adults, toddlers and infants (there was no difficulty in school children), it took a Sunday morning's sermon on the vice of ingratitude in general and the ingratitude of the bush Negroes in particular, and the most direful threats of never getting any more medicine, to induce them to be examined by me.

The result of this examination comprising about 400 people was, by itself, in no way astonishing. It was identical with that which has been found by others, and by myself, among certain groups of Negroes in Africa. Without encumbering you with too many figures, I may say that the spleenrate of infants and toddlers was well over 80 per cent. It sank to 75 per cent. in younger school children, to 50 per cent. in older school children and, finally, to 15 per cent. in adults, *i.e.*, people of sixteen years and over. The spleenrate, which in Europeans and Asiatics is such a reliable gauge of malarial conditions, proved wholly inadequate to evaluate the extent of malarial infection in this village. For whereas no more than two fifths of the toddlers and three quarters of the younger school children showed splenic enlargement, nearly all of them had parasites in their blood in numbers sufficient to be detected by a three minutes' search of a thick film. The older school children whose spleen showed palpable enlargement in no more than half of the cases had parasites in their blood in three quarters of the lot, and about one third of the adults were infected, although less than one sixth of them showed splenic enlargement. The infants were the only ones to sustain the honor of the spleenrate as a reliable malariometric figure. Their spleenrate almost reached 90 per cent., their parasite rate 80 per cent. only.

All this, I repeat, is nothing new. Similar high figures have been found in other Negro populations. I may point your attention, however, to the fact that they are rare among Asiatic populations, as has been pointed out by Schüffner. In highly permanently malarious areas of the Dutch East Indies, for instance, the spleenrate in school children and adults maintains the high level which it reached in toddlers, but the parasite rate never attains to the tremendously high levels we see in heavily and permanently infected Negro populations. Moreover, it drops to a very low level in adults.

The figures I quoted, however, claim especial interest if we remember that this was the same population which, at the time of the examination, was paid an unwonted visit by a medical man whose open-air surgery was crowded every day for ten days, to whom people came for all manner of complaints from which they, their children, their toddlers, their infants were suffering. And from that population, with all its eagerness for treatment, we did not succeed in collecting more than a paltry fourteen fever-patients.

Of course, it might be objected that the statement of three fourths of the infants and nearly all the toddlers and younger school children being infected with malaria parasites does not greatly impress one so long as one does not know how many parasites they were carrying at the time of examination. It is all very well to say that these children apparently were in excellent health, although they were parasite carriers. But if "being a parasite carrier" simply means that a few parasites were found after three minutes' search, it is not so difficult to believe that they were not actually ill at the time of examination. To meet this objection let me tell you that about four fifths of the infants and the toddlers carrying parasites had at least one parasite for every ten leucocytes, a number amply sufficient to render any man of, say, my stamp thoroughly miserable, all the more so since the majority of infections are falciparum. But those brats did not care a bit!

No, they did not care a bit within that period of ten days. But that is only a snapshot. But how did they fare later on? I can not tell you. But I can tell you how they fared earlier in the year and in the preceding years. And since this year was in no way abnormal, from a health point of view (as the local European nurse, stationed there for over four years, assured us), we may assume that malaria infection was normal too. Well, in the year preceding our investigation, the general mortality in that bush Negro village was 16 per thousand, the natality 34 per thousand and the infant mortality 71 per thousand infants born alive. Over the last twelve years (from 1927–1938) the general mortality was 21 per thousand and the infant mortality 107 per thousand. These are figures which would not show well in a proud American city or, if I may say so with some satisfaction, in a town like Amsterdam. But even as late as 1919 infant mortality over the whole of the Netherlands ranged still over 90 per thousand. So we may conclude that high and constant malarial infection to which these bush Negroes are subjected not only leaves the adults unaffected but does little harm even to the youngest children. At any rate, we are in that village far away from that condition of immunity in adults, described to be attained over the corpses of thousands of young children. Allow me to repeat that this description is absolutely correct. Such conditions do exist. But not among these bush Negroes.

And how to return to the point from which I started—the efficient parasite. I suppose you have, by now, gathered what I mean by this word. Plasmodium falciparum, vivax, malariae, they all are efficient parasites in the collective bodies of that bush Negro population. Certainly things did not proceed as smoothly as might have been expected from ideally efficient parasites. There is some struggle, as exemplified by the splenic reaction in children, which even in adults has not quite subsided. And the heavy drop in the number of parasites per carrier (in adult carriers more than nine tenths have less than one parasite per 10 leucocytes) also shows that the parasites pay for the benefit of continuing in the adult human host by strictly enforced birth control. All the same, compared with the interaction of the parasite and the white human host, we may safely conclude that the parasites in the bush Negroes are fairly efficient and that there is little likelihood of extinction of either species, man or plasmodium.

But what one may well ask is this. Who deserves the epithet "efficient"—the parasite or the host? Had not the title of the paper better be "The Efficient Host"? In this case this is undoubtedly true. These same parasites which behaved in such an exemplary manner in the bush Negro's body, behaved very badly in my own. It is the bush Negro's body which, first by refusing to be killed, and afterwards by a judicious and not too far carried reduction of the number of parasites, finally obtains that nicely adjusted equilibrium which does not even require the intervention of the spleen. Nevertheless, I maintain the parasite's claim to the title of "efficient" since it allows itself to be domesticated in this way.

So we come to this conclusion. If we see a parasite behaving as it should behave—not harming its host and, as a consequence, not harming itself—in short, if we see it behaving as an efficient parasite, we know that this is the outcome of an interaction between host and parasite of a struggle in which both have had to sacrifice something. The host has had to get rid of his over-sensitiveness, he has had to become tolerant of the parasite's presence in his body. And the parasite has had to suffer a considerable reduction in its procreative powers. It is an adaptation of the host to a greatly subdued parasite. The Negro body, better than the body of most human beings, seems extraordinarily well fitted to pass unscathed through the various stages of this adaptation.

And now, finally, you will allow me to say something on the subject which I have had in mind these last five months: the settlement of political refugees in the tropics, more especially in the Guianas. It has little to do with the efficient parasite but a great deal with the propensity of the African race to act as a highly efficient host of the malaria parasites.

Up till now the importance of this peculiarity of the African race has been underrated because many of the greatest authorities have refused to regard it as a racial quality by which the African races fundamentally differ from other races. Every race can acquire some measure of immunity to malaria. The African race, together with a few obscure hill-tribes in India, are the only ones to be born with it.

I need hardly emphasize that this racial quality affords the Africans a considerable advantage over the other races in the case of the interracial struggle for existence developing in an environment in which malaria plays an important part. I am not going to enlarge on this subject which would completely carry me away from the beaten track I am following. To those who wish to reflect on this remark of mine, I would recommend the perusal of Grenfell Price's book on "White Settlement in the Tropics," recently issued by the American Geographical Society. Notably, his remarks on the fate of the white race in some parts of the tropical world are worth reading in this connection.

But this I would say. Any attempt at settlement of whites in areas where malaria is rife and where, by the conditions under which the settlement is organized they will have to compete with the African race on a footing approaching equality, is bound to be a cruel failure unless malaria has been reduced to insignificance before the settlement is started or unless an enforced segregation is rigorously applied to keep the two races so much apart that there can be no longer any competition between the two.

I realize that my address has been somewhat out of tune with the highly cultured scientific sphere of this congress, where the serene atmosphere of the laboratory and the lecture room prevails. I came here directly from the wilds. The field has been my laboratory for months and I have consorted more with bush Negroes and Indians than with cultured people. Moreover, I can not get rid at a moment's notice of the ideas and interests which have occupied my mind since I left Holland and which, although of little importance in the present circumstances, are bound to clamor for notice at some future date. Accept my address as a contribution to the vexed question of the host-parasite relationship. That I did not quite succeed at the end in keeping away from the subject I have very much at heart must be regarded as an amiable mental aberration comparable with that from which one of Charles Dickens's famous characters of fiction suffered when he never succeeded in keeping King Charles' head out of the Memorial he was writing. If I had had Mr. Dick's unlimited time at my disposal I would have torn up this memorial to write another one. Since I had not the time, I had to offer it to you as it is.

THE KINETICS OF CONTACT CATALYSTS AND THE INDUSTRIAL BACKGROUND[1]

By Dr. HUGH STOTT TAYLOR

DAVID B. JONES PROFESSOR OF CHEMISTRY, PRINCETON UNIVERSITY

It is a tragedy of the efforts of the student of chemical reactions at surfaces, in these closing decades of the two centuries of service to culture and civilization that the University of Pennsylvania is now celebrating, that the finest flowers of the effort should have synchronized with and been made subservient to the international tragedy of 1914–1918 and that which now burdens the human race. It was not mere accident that, in the decade preceding the first Great War, out of the fundamental researches of Sabatier on the capacity of nickel and other metals to induce the combination of hydrogen with unsaturated substances, there emerged the answer to the famous query of Napoleon to his French scientists one hundred years earlier as to the possibility, in a blockaded country, of converting liquid fats into the solid fats necessary for the production of margarine and of soaps. It was a proud boast of an English technician in 1919 that they had succeeded in converting fifth-grade whale oil into edible fats in the last years of the first World War. It can not be chance alone that the industrialization of Haber's researches on the fixation of atmospheric nitrogen and the production of the ammonia necessary for fertilizers and explosives should have been achieved on the eve of that same war which found Germany cut off, by British sea-power, from the only hitherto available source of fixed nitrogen, the nitrate deposits of Chile. These processes demanded in their turn cheaper sources of hydrogen. This was achieved by new processes of formation at catalytic surfaces and put to use for the filling of those now archaic "sausage balloons" that served as observation posts on the battle lines of Flanders. To-day it is the "barrage balloons" that use hydrogen to protect areas against the invasions of invading bombers.

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[1] Read at the Bicentennial Conference of the University of Pennsylvania, September 17, 1940.

Two decades of "progress" demanded the solution of new problems for the coming new war. The mechanization of transport has profoundly modified the technique of modern warfare. The present distribution of sea-power compelled a blockaded country to ensure for herself either accessibility to the necessary raw materials of transport such as oil and rubber or alternatively so to shape her technological development as to insure the production of such materials synthetically from raw materials available within the blockaded area. Within Germany during the last years there have been developed, by means of reactions at surfaces, methods of converting coal into high quality aviation gasoline and synthetic rubber materials which have gone far towards making that country independent of supplies from abroad. Similarly, her need for fats, mitigated in part by her conquests of the present year, demanded the replacement of the fats used in soap manufacture by synthetic detergents and the development of methods for the conversion of available raw materials into synthetic fatty acids. Marked progress has been achieved in these directions.

Even in the case of countries open to the available resources of nature it has been found that nature does not always produce the most highly desirable forms of the materials to be consumed. Petroleum supplies an excellent example of such a situation. In the early days of the automobile, adequate fuels could be obtained by simple distillation of crude oil. Improvements were demanded by increasing fuel requirements which led to the development of cracking processes for increasing the gasoline fraction from a given barrel of crude. The demand for increased power in the automobile, stimulated further by progress in aviation, led to the realization that certain types of gasoline molecules, notably iso-octane, possess fuel characteristics that far exceed those of other molecules within the range of volatility demanded by the engines in question. New problems were thus presented to the chemist, the conversion of low-grade natural products into the more valuable high-grade fuels. In the solution of these problems the catalytic chemist has made notable contributions. Catalytic methods have been developed for cracking complex petroleum molecules into simpler high-grade automobile and aviation fuels, for polymerizing or putting together the simpler hydrocarbon molecules to form molecules of high antiknock value in the gasoline range, for adding simpler saturated molecules to unsaturated molecules to form valuable fuels, the so-called processes of catalytic alkylation; catalytic isomerization, the changing of molecules of a given configuration to other configurations more powerful in fuel characteristics, catalytic dehydrogenation, which, coupled with catalytic processes of ring formation, lead to the formation of aromatic fuels containing benzene, toluene and xylene. As a by-product of these latter new processes of dehydro-aromatization the petroleum industry is becoming an active competitor of the by-product coke oven industry upon which, hitherto, we have been dependent entirely for the raw materials of the dyestuff industry, explosives and many pharmaceutical preparations.

Paralleling in intensity these developments with the more complex units of petroleum raw materials a series of efforts have evaluated the lighter constituents of petroleum, natural gas and the cracked gases of refinery operations. Catalytic processes have been developed for the direct oxidation of ethylene at metal surfaces, notably silver surfaces, to yield ethylene oxide, itself a reagent of great value in a series of synthetic processes and the intermediate in the production of ethylene glycol, a product now required on a tonnage basis for anti-freeze solutions. Propylene, the next higher unsaturated olefinic hydrocarbon, is by reason of a newly developed process, the raw material for synthetic production of glycerine available at any moment when the by-product glycerine of soap manufacture becomes inadequate to meet the demands. Butene, a four-carbon atom olefine, yields by further catalytic removal of hydrogen the butadiene which is the starting material for the synthetic rubbers of the Buna-types developed in Germany. There, due to lack of petroleum, coal is the raw material and the production of butadiene occurs via the formation of calcium carbide and acetylene. That butadiene, under the influence of metallic sodium, would polymerize to a rubber-like material has been known since the end of the last century. It was such materials which were employed as rubber substitutes by the Germans in the latter phases of the last war. The progress achieved in the recent researches arises from the discovery that "cross-polymerization," the introduction of other molecules into the growing unit, rubber, like the plastics, cellulose, starch, etc., being "macro-molecular," that is, composed of large numbers of constituent units combined with each other into a structural pattern conferring on the mass its particular characteristics. The newer synthetic rubbers build into the growing butadiene polymer such other materials as styrene and acrylic nitrile with the result that products having abrasion characteristics and resistance to oxidation, and therefore to deterioration, are from 5 to 30 per cent. better than the best natural rubbers that have been produced. Superior characteristics over the natural products also obtain in the case of such special products as neo-prene and thiokol, which, in addition to their carbon and hydrogen constituents, contain also chlorine and sulphur respectively, thus deviating markedly in constitution from the natural product, possessing properties which for certain purposes render them more valuable than the natural product.

In the field of plastics also the chemistry of reactions at surfaces is making notable contributions. These materials have almost endless uses and possibilities alike for peacetime and war uses. They can be used as substitutes for metals and for glass. Optical instruments, aeroplane parts, possibly even impregnating material for ply-wood aeroplane wings are among their immediate uses in the era of defense now upon us. Solvents for plastics, ethers, alcohols and esters are allied materials that the catalytic chemist is contributing. From these researches also stem the newer synthetic fibers of which nylon as a material superior in many characteristics to silk is now in large-scale production. The raw materials from which they are made, coal, limestone, petroleum, water and air require the chemistry of reactions at surfaces for the transformations that ultimately yield the desired products.

America can face the intense competition that rages in this field with equanimity. Thanks to her universities and the large bodies of trained personnel which they have turned out American chemical industry finds itself to-day in a vastly more favorable position, when national emergency once more confronts her, than 25 years ago. During this quarter of a century the industry has grown from the tiniest of infants to a giant, has seized the initiative from all competitors and potentially can outstrip them all. Side by side with the intensive industrial developments here outlined there has grown up also in industrial research, governmental and university laboratories a broad program of theoretical study in this field. Upon the pioneering investigations of Langmuir has been built a body of theoretical fundamental knowledge, the major contributions to which have come from American laboratories, and with the aid of which a more rapid and certain approach to the solution of problems of industry can be achieved. Langmuir recognized that the seat of chemical change at surfaces was a layer of absorbed gas one molecule thick associated with the surface by chemical forces. The heterogeneity of catalytic surfaces was then recognized and its importance in the interpretation of the great sensitivity of surfaces to poisons became understood. This concept led also to an understanding of the phenomenon of promoter action whereby, with suitable added material, the efficiency of a given quantity of catalyst material could be enormously enhanced. The quantitative extent of the surface could be increased and its quality multiplied. Later researches revealed that two types of association of a gas with a surface, the one physical, the other chemical, could obtain and that the operating temperatures determined which type of interaction occurred. With different surfaces, different temperature ranges could be employed. The range of catalytic materials and the temperature ranges in which they operate were correspondingly expanded. With the advent of isotope separations, signalized by Urey's discovery of heavy hydrogen, followed by heavy oxygen, carbon, nitrogen and sulfur, new tools became available for the study of the associations with surfaces involved in catalytic changes. To-day the analysis is going yet deeper. With the modern tools of x-ray and electron diffraction the catalytic chemist is examining the activities of individual faces of crystals and is demonstrating that the geometrical configurations characteristic of particular faces are more favorable to the activation of reactants than are other faces. As a consequence methods can be developed to produce the desired crystal faces in preponderant amount. Twenty-five years ago the science of catalysis was almost purely empirical, dependent entirely on trial and error. As the University of Pennsylvania enters upon its third century of intellectual effort, the chemistry of reactions at surfaces has become a highly refined scientific study, rich in possibilities for applied science and in joyous endeavor for the fundamental scientist.

SCIENTIFIC EVENTS

THE AUSTRALIAN COMMITTEE ON ANIMAL PRODUCTION

THE *Australian Journal of Science* in an account of the Constitution and Work of the Australian Committee on Animal Production states that at the invitation of the Commonwealth Government, Dr. J. Hammond, of the Animal Nutrition Research Institute of the University of Cambridge, visited Australia in the autumn of 1938. He has submitted a report on the conditions of Animal Production in Australia, making the following recommendations:

> The major problems of the Australian Meat Board, the Australian Dairy Produce Export Board and the Australian Wool Board, are of general Commonwealth concern, and it would appear that the progress of the animal industry in Australia could best be served if an Advisory Committee of the Council for Scientific and Industrial Research comprising representatives from these Boards, the Council, the Department of Commerce and Standing Committee on Agriculture, could be set up to make suggestions concerning work to be done in animal production, to accept responsibility for conducting the scientific work fundamental to the industry, and to coordinate the technical work going on in the different states through the research officers suggested above or by other means agreeable to the states.

This recommendation, according to the journal, sounded a rallying note welcomed by most of the bodies in question, so that at a meeting held in Melbourne and convened by the Australian Meat Board, representatives of all the State Agricultural Departments, the Australian Meat Board, the Australian Dairy Produce Board and the Council for Scieintific and Industrial Research agreed that the establishment of such a committee would be advantageous.

The proposed body has become the Australian Committee on Animal Production. Its chairman is the Hon. H. S. Henley, a member of the Australian Meat Board. Its members are Dr. A. E. V. Richardson and Dr. L. B. Bull, of the Council of Scientific and Industrial Research; W. J. Spafford, director of agriculture, South Australia; A. H. E. McDonald, of the Department of Agriculture, New South Wales; G. K. Baron-Hay, of the Department of Agriculture, Western Australia; F. W. Hicks, of the Department of Agriculture, Tasmania; H. A. Mullett, director of agriculture, Victoria; Professor Seddon, representing the Queensland Department of Agriculture; Ross Grant, of the Department of Commerce, and J. Proud, of the Australian Dairy Produce Board. A. J. Vasey, of the Division of Animal Health and Nutrition, Council for Scientific and Industrial Research, is secretary.

The Animal Production Committee early appointed technical subcommittees to which were referred for consideration the report of Dr. Hammond and that of J. M. Coleman upon Fat Lamb Production in Australia.

There were five of these technical subcommittees, each of which dealt with a branch of animal production. These subcommittees dissolve automatically after their reports have been submitted.

THE DUTCH ELM DISEASE IN CONNECTICUT

DESPITE federal, state and local efforts to check the Dutch elm disease in Connecticut, the Agricultural Experiment Station at New Haven reports slow but steady increase and spread in 1940. Fourteen new towns were brought into the zone of infection as a result of summer scouting. One diseased tree was found at Preston, thirty miles from the nearest point of infection. Nevertheless efforts to save the elms continue—the federal work through the Dutch elm disease office of the U. S. Department of Agriculture, and state work through the Experiment Station, represented by Dr. Roger B. Friend, state entomologist.

Altogether, Connecticut has found 1,686 cases of Dutch elm disease since the infection first appeared there in 1933. Many of the 378 diseased elms found last summer occurred outside the areas of infection. In general the spread was from adjacent towns where the disease had been found previously. The point of infection nearest to Preston, however, is Old Lyme, 30 miles away, where the last case appeared in 1937. Old Lyme lost seven trees in three years. At that time stringent measures were taken to destroy all dead and dying elms or parts of elms that might attract elm bark beetles, carriers of Dutch elm disease. Apparently the job was thorough since no more cases have been found in the vicinity.

During 1940 the U. S. Department of Agriculture has been responsible for scouting, elm sanitation and clean-up work in the state. Through its legal authority to carry on projects on private property when necessary, the Experiment Station cooperates with the federal agents by obtaining this permission for them. The station also is engaged in research, seeking a possible cure or control for the disease. This has involved an intensive study of the elm bark beetles and the materials that might repel or kill them, and the use of chemicals in disease control. So far no spray has been found that will prevent beetle feeding in the crotches of elms. However, creosote treatment of felled timber keeps them from breeding under the bark.

When trees showed outward symptoms of the disease, wilting and yellowing of foliage on terminal twigs, the scouts took samples for further examination. Any that showed the characteristic dark streaking under the bark were sent to the federal laboratory at Bloomfield, N. J., for culture. Specimens from elms in territory never before infected were also cultured at the Experiment Station. All those found diseased have been removed and burned so that beetles under their bark can not carry infection to healthy elms.

During the cold months the federal men will engage in elm sanitation work. This consists of looking for elm material infested by bark beetles and material which may be attractive for beetle breeding next spring. When it is necessary to remove trees, owners have the choice of cutting the wood and storing it in an approved manner, or of turning the job over to the government completely. Logs may be stored in tight cellars or bins from which the beetles can not escape, or debarked and left outdoors. The federal method is to burn all the elm wood.

EXPEDITION TO THE BADLANDS OF SOUTH DAKOTA

ACCORDING to a bulletin of the National Geographic Society, after three months spent in prospecting and in excavating fossil bones in the Badlands of South Dakota, an expedition, sent out jointly by the National Geographic Society and the South Dakota State School of Mines, has completed its season's work with an unusually large and valuable collection of specimens. The one hundred and seventy-five or more specimens, weighing several tons, are now at the School of Mines in Rapid City, S. D., where the work of preparing and mounting them for exhibition is being carried on. Preliminary investigations indicate that they include several species and genera new to science. Probably included in that category will be a rhinoceros represented by a skull twenty-eight inches long, and a pig (also represented by a skull) which, when alive, measured fully eight feet from snout to tail.

Among other specimens found by the expedition were fossil bones of tapirs, little three-toed horses (the remote ancestors of present-day horses), protoceros (remotely related to deer and antelope), the little-known ancodus and a number of small rodents. Rarest of the specimens are bones of birds—only a few have previously been found in the Badlands. The principal find in this group was a fossil egg still firmly held in its matrix of rock. A few plant fossils were found of fossil hackberry seeds and petrified hackberry wood.

The expedition, led by Dr. Joseph P. Connolly, president of the School of Mines, and James D. Bump, curator of the School of Mines Museum, including seven other members, established camp in an eroded region twenty-five miles from the nearest highway. Its work was carried on in the summer sunshine where mid-afternoon temperatures frequently reached 120 and 130 degrees Fahrenheit. Some of the heaviest specimens were found near the tops of high, slender pinnacles and had to be lowered by block-and-tackle.

The material collected by the expedition is particularly rich in rare specimens because the work was confined to geological formations in which very little work had been done heretofore. These are the Channel Sandstones, so called because the beds were formed by deposits filling stream channels worn in the clay surfaces in Oligocene times, probably thirty million years ago. The surrounding clay—now turned to shale—is softer and much more easily worked, and from it have come most of the specimens previously collected.

PORTRAITS OF DISTINGUISHED CHEMISTS

The News Edition of the American Chemical Society states that "Portraits of Distinguished Chemists," published by the *Journal of Chemical Education,* consists of reprints of particularly important frontispieces which have appeared in the journal from time to time. These pictures, carefully printed on the finest grade of coated paper, in addition to their chemical interest have an artistic quality that entitles them to a place in a living room or library.

"There are 48 portraits, divided into three series of 16 each, printed on separate sheets, 8 by 10.5 inches in size, and similar in every respect. Their instructive value is increased by descriptive legends stating the important facts of each man's career, his dates and reference citations. These legends are visible when the portraits are framed."

Each series is enclosed in a portfolio of deep red cover stock on which are printed the names of the chemists whose portraits it contains. A list of these names follows:

SERIES A

Svante Arrhenius, Adolf von Baeyer, M. Berthelot, Robert Boyle, Stanislao Cannizzaro, Madame Curie, J. H. van 't Hoff, Michael Faraday, H. Le Châtelier, Justus von Liebig, Dmitri Mendeléeff, Louis Pasteur, Sir William Perkin, Joseph Priestley, Sir William Ramsay, Friedrich Wöhler.

SERIES B

Francis W. Aston, Robert W. Bunsen, James Mason Crafts, John Dalton, Emil Fischer, J. Willard Gibbs, W. F. Hillebrand, Irving Langmuir, Henri Moissan, Walther Nernst, Wilhelm Ostwald, T. W. Richards, Benjamin Rush, Paul Sabatier, Benjamin Silliman, Benjamin Thompson.

SERIES C

Joseph Black, Herman Boerhaave, Irène Joliot Curie, Sir James Dewar, Victor Grignard, Fritz Haber, Charles

M. Hall, Robert Hare, Frédéric Joliot, Achille Le Bel, M. V. Lomonósov, Bernard Palissy, C. F. Schönbein, Paul Schutzenberger, Edgar Fahs Smith, Harvey W. Wiley.

LECTURES TO THE LAITY OF THE NEW YORK ACADEMY OF MEDICINE

THE sixth Series of Lectures to the Laity of the New York Academy of Medicine opened on November 14 with a lecture by Dr. Alan Gregg, director of the Medical Sciences of the Rockefeller Foundation, which was presided over by Dr. Malcolm Goodridge. Dr. Gregg pointed out that "the history of humanism shows that it began in protest at too much preoccupation with theology. The potential role of humanism to-day is to carry man, and especially the physician, beyond the limitations of natural science."

Other lectures in the series are as follows:

December 12, 8:15 P.M. Psychiatry and the Normal Life, by William Healy, M.D., director, Judge Baker Guidance Center, Boston. To what extent should the normal man be educated in psychiatric understandings for the sake of better management of himself and the advancement of civilization? *Presiding chairman,* Nolan D. C. Lewis, M.D.

January 23, 8:15 P.M. Paracelsus in the Light of Four Hundred Years, by Henry E. Sigerist, M.D., director of the Institute of History of Medicine, the Johns Hopkins University. Paracelsus was not only one of the greatest physicians of the Renaissance but also one of its great philosophers. His courageous and original approach to the problems of life and death, health and disease, physician and patient, gave him a unique position in the medical world and to-day, four hundred years after his death, he still brings us a significant message. *Presiding chairman,* Alfred E. Cohn, M.D.

February 27, 8:15 P.M. What We Do Know about Cancer, by Francis Carter Wood, M.D., director of Radio Therapeutic Department, St. Luke's Hospital, New York City. A review of the vast amount of research work on animals and of the clinical investigations of cancer, by the newer methods, which have yielded a large amount of knowledge, much of which is still unfamiliar to the layman. *Presiding chairman,* C. P. Rhoads, M.D.

March 27, 8:15 P.M. Philosophy as Therapy, by Irwin Edman, Ph.D., professor of philosophy, Columbia University. The possible union of empirical psychiatric investigation and the delicate insights of philosophical analysis. Philosophy may still have medicinal uses, and medicine itself may gain by the techniques and perspectives provided by philosophical discipline. *Presiding chairman,* Eugene H. Pool, M.D.

April 24, 8:15 P.M. The Promise of Endocrinology, by Oscar Riddle, Ph.D., Carnegie Institution of Washington, Department of Genetics, Cold Spring Harbor, N. Y. What is known about the regulation of body functions by hormones. The use of purified hormones in maintaining health and in combating disease. *Presiding chairman,* David Marine, M.D.

RECENT DEATHS AND MEMORIALS

DR. RAYMOND PEARL, professor of biology in the School of Medicine and in the School of Hygiene and Public Health of the Johns Hopkins University, died suddenly on November 17 at the age of sixty-one years.

DR. OLIVER THOMAS OSBORNE, emeritus professor of therapeutics at the Medical School of Yale University, died on November 11 at the age of seventy-eight years.

ELNATHAN KEMPER NELSON, senior chemist in the Food Research Division of the Bureau of Chemistry and Soils of the U. S. Department of Agriculture, with which he had been connected for thirty years, died on November 10 in his seventieth year.

DR. OTTO E. PLATH, entomologist and professor of biology at Boston University, died on November 5 at the age of fifty-five years.

GRACE A. SANDHOUSE, since 1926 a specialist in the identification of bees and wasps in the Bureau of Entomology and Plant Quarantine, died on November 9 at the age of forty-four years.

IN recording the death of Dr. Carl Alsberg, it was said that he was director since 1937 of the Giannini Foundation of Stanford University. It should have been said that since October, 1937, he was director of the Giannini Foundation of Agricultural Economics of the University of California at Berkeley. Previously, he was director of the Food Research Institute at Stanford University.

THE *Journal* of the American Medical Association states that a Mayo Memorial Commission has been appointed by Governor Harold E. Stassen, of Minnesota, to study a proposal for the establishment of a fund of $250,000 through public subscription throughout the world for a memorial to the late Drs. William J. and Charles H. Mayo. State Senator William B. Richardson, of Rochester, is chairman of the commission, which is composed of seventeen representative citizens of Minnesota.

SCIENTIFIC NOTES AND NEWS

THE Rudolf Matas Medal for vascular surgery of the School of Medicine of Tulane University was presented on November 14 to Dr. Daniel Collier Elkin, professor of surgery at Emory University, Atlanta.

THE Collier Trophy, presented annually since 1911 for achievement in aviation, has been awarded to Dr. Walter Boothby and Dr. W. Randolph Lovelace, II, of the Mayo Clinic, Rochester, Minn., and to Captain

Harry Armstrong, of the Army Medical Corps, for their researches on the effect on the brain, nerves, blood and reflexes of an aviator when he ascends to the stratosphere.

At the sixtieth annual dinner on November 1 of the Associate Alumni of the College of the City of New York, which was given at the Hotel Biltmore, five Townsend Harris medals and four Alumni Service medals were presented to alumni of the college for "notable achievement." Among the recipients of the Harris medals were Dr. Alexander O. Gettler, professor of toxicology at the Medical College, and Dr. Louis I. Dublin, vice-president of the Metropolitan Insurance Company. Among the speakers at the dinner were Sir Norman Angell, the British economist, and Dr. Stephen Pierce Duggan, director of the Institute of International Education, New York.

The gold medal of the Holland Society, awarded each year to "a man prominent in the arts, sciences or humanities," was presented at a dinner of the society on November 14 to Henry Ford in recognition of "his achievements in introducing and developing the art of mass production in industrial manufacture."

At a meeting of the trustees on November 19 the department of anatomy of the New York Medical College was named the "William Waldo Blackman Laboratory of Anatomy." Dr. Blackman is an alumnus, formerly professor of anatomy at the college, and at present vice-chairman of the Board of Trustees. Professor William K. Gregory, of the American Museum of Natural History, delivered the address of the evening on "Evolutional Causes of the Misery of Mankind." Dr. C. E. Tharaldsen, professor of anatomy, presided over the ceremonies at which President C. A. Burrett, Clifford Hemphill and Dr. Charles E. Birch, of the Board of Trustees, paid tribute to Dr. Blackman.

Dr. James Franck, professor of physics at the Johns Hopkins University, will give the Hitchcock lectures at the University of California at Berkeley during March. As already announced in Science, Dr. Walter B. Cannon, George Higginson professor of physiology at Harvard University, will lecture on the Hitchcock Foundation in February.

Dr. Ralph Irving Lloyd, Brooklyn, N. Y., has been named president-elect of the American Academy of Ophthalmology and Otolaryngology, which met at Cleveland from October 6 to 10. Vice-presidents elected are Drs. Everett L. Goar, Houston; James M. Robb, Detroit, and Ralph O. Rychener, Memphis. Dr. Frank R. Spencer, Boulder, Colo., will be president during the coming year.

Officers of the Council on Dental Education of the American Dental Association for the coming year are: *Chairman,* Dr. Minor J. Terry, secretary of the New York State Board of Dental Examiners, and *Vice-chairman,* Dr. J. Ben Robinson, of the Baltimore College of Dental Surgery.

The list of officers of the Society of American Bacteriologists given in the issue of Science for November 8, p. 425, referred to the New York branch of the society, not to the national organization.

At Harvard University, promotions to the rank of associate professor have been announced as follows: Dr. Edward S. Castle, physiology; Dr. George L. Clarke and Dr. John H. Welsh, Jr., zoology.

Gerald M. Ridenour, associate in water and sewage research at the New Jersey Agricultural Experiment Station and assistant professor in the Department of Water Supplies and Sewage Disposal at Rutgers University, has become associate professor of sanitary engineering at the Pennsylvania State College.

Dr. John A. Cameron, assistant professor of zoology, has been appointed assistant professor of anatomy at the Medical School of the University of Missouri, to succeed Dr. L. J. Wells, who has been appointed associate professor of anatomy at the Medical School of the University of Minnesota.

Dr. Willis L. Tressler, of the department of biology of the University of Buffalo, has been appointed assistant professor in the department of zoology of the University of Maryland, where he will be associated, also, with the Chesapeake Biological Laboratory as planktologist.

Dr. Dorothy Day, professor of botany at Smith College, has leave of absence for a year, which she plans to spend at the New York Botanical Garden working in the laboratory of Dr. William J. Robbins, director of the garden.

The Committee on Scientific Research of the American Medical Association has made grants as follows: to Dr. Arthur M. Lassek, professor and chairman of the department of anatomy at the Medical College of the State of South Carolina, for his investigation of the pyramidal tract in man and other higher primates; to Dr. Harry Beckman, of the School of Medicine of Marquette University, in partial support of the renewal for another year of his studies in the prophylaxis of avian malaria, and to Dr. Wesley W. Spink, assistant professor of medicine at the Medical School of the University of Minnesota, to support an investigation of antistaphylococcal immunity and the nutritional requirements of staphylococci. Dr. Spink has also received a grant from Merck and Company in support of a study of ascorbic acid.

Dr. Raymond L. Ditmars, of the New York Zoological Park, has been appointed curator of the department of insects which will be established at the garden in the spring. Permanent and seasonal exhibits are planned. Dr. Ditmars will relinquish the active curatorship of the department of mammals which he holds in addition to that of reptiles, in order that he may devote more attention to the new branch.

Dr. Joseph W. Barker, dean of the School of Engineering of Columbia University, has been named regional adviser for New York and Long Island in the Federal program to train men quickly for engineering work in the defense industries.

Dean Alexander S. Langsdorf, of the Schools of Engineering and Architecture of Washington University, St. Louis, has been named regional adviser of the Engineering Defense Training program. He will visit industrial plants in Missouri, Kansas, Arkansas, Oklahoma and West Tennessee to determine what help is needed from engineering schools in obtaining men for work in connection with the defense program and will ascertain what courses in the schools are available and what the cost will be. The Government will bear tuition expenses. Dean R. A. Seaton, of the Kansas State College, who was succeeded as regional adviser by Dr. Langsdorf, has been made national chairman of the program.

Dr. Bostwick H. Ketchum, associate in marine biology at the Oceanographic Institution at Woods Hole, Mass., sailed on November 15 for Bermuda to study the effect of bacterial slime on the fouling of ships' bottoms.

Dr. Oliver S. Ormsby will deliver the presidential address at the twenty-fifth annual meeting of the Institute of Medicine of Chicago to be held at the Palmer House on the evening of December 3. He will speak on "Pellagra." The annual dinner and business meeting of the fellows will be held preceding the lecture when citizen fellowships will be conferred.

Dr. Charles H. Best, professor of physiology at the University of Toronto, will deliver the second Harvey Society Lecture of the current series at the New York Academy of Medicine on November 28. Dr. Best will speak on "Thrombosis and the Action of Heparin."

Professor A. N. Richards, chairman of the Local Committee of Arrangements of the recent meeting of the National Academy of Sciences at the University of Pennsylvania, writes: "I beg to request that you publish the fact that the communication entitled 'Artificial mixing of incompatible germ-plasms in Drosophila,' read by Dr. Hermann J. Muller before the National Academy of Sciences at its autumn meeting on October 28, published in abstract on page 418 of the issue of Science for November 8, 1940, was a joint communication by Professor Muller and Dr. G. Pontecorvo. The omission of Dr. Pontecorvo's name from the final program was the result of a regrettable oversight."

The United States Civil Service Commission, Washington, D. C., wishes to secure professional physicists to fill positions in connection with the national defense program of the Federal Government. These positions include the following grades: Physicist (any specialized branch), $3,800 a year; also principal, $5,600; senior, $4,600; associate, $3,200; assistant, $2,600 a year. Applications must be filed with the Commission's Washington office not later than December 12. Applicants for all grades must have completed a 4-year college course; for the three higher grades they must have completed at least 24 semester hours in physics. In addition, for all grades, applicants must have had professional experience in physics. Substitution of graduate study in a specialized branch of physics may be allowed for part of the experience. Applicants for the two lower grades will be given a written test on general and professional questions. No written test is necessary for the higher grades. Candidates will be rated on their qualifications as shown in their applications and on corroborative evidence.

The Committee on Scientific Research of the American Medical Association invites applications for grants of money to aid in research on problems bearing more or less directly on clinical medicine. Preference is given to requests for moderate amounts to meet specific needs. Application forms may be obtained from the Committee at 535 North Dearborn Street, Chicago, Illinois.

Original unpublished essays on any subject in the field of plants useful to man are eligible for the Walker Prize competition for 1941. Further information may be had from the Secretary, 234 Berkeley Street, Boston. The closing date is May 1, 1941.

The funds for a fellowship of $2,000 to enable Latin American physicians to pursue graduate studies at Mount Sinai Hospital in any of the clinical or laboratory departments have been provided by the Dazian Foundation for Medical Research.

Facilities of the department of mathematics of the University of Cincinnati for research studies centering on special problems of aviation have been offered to the United States Army Air Corps staff at Wright Field, Dayton. The offer is an outgrowth of a survey of the research facilities and personnel of the university in the field of the physical sciences and mathematics which Professor Louis Brand conducted during the summer at the request of the National Research Council.

DR. RICHARD B. GOLDSCHMIDT, professor of zoology at the University of California at Berkeley, has presented to the university a collection of letters from eminent biologists of the twentieth century. The letters form part of correspondence with Dr. Goldschmidt. The collection does not contain complete sets of the correspondence, as a large part of Dr. Goldschmidt's files were destroyed when he left Germany in 1936.

THE exhibits, on science, agriculture and education, prepared by the University of California for the Golden Gate International Exposition in San Francisco, valued at $80,000, have been presented to the university by the California Commission, a body created by the Governor to aid the Exposition. The exhibit "Science in the Service of Man" was prepared by the university with the cooperation of other educational institutions, and some of the exhibits from the Hall of Science will be presented to these institutions. President Sproul's committee to assist the commission will distribute the exhibits to the seven divisions and the various departments of the university. They will be used primarily for teaching and research purposes.

AN expanded program of research in pulp, paper and related products is provided for in a new agreement entered into by the Federal Department of Mines and Resources with the Canadian Pulp and Paper Association and McGill University. According to *The New York Times,* under the terms of this agreement the association undertakes to provide greatly increased support for the extension of studies aimed at the improvement of production methods and the reduction of manufacturing costs. The first agreement for such cooperative activity was entered into twelve years ago, at which time the association erected a special research building on a site provided by McGill University. It is pointed out by the *Times* that McGill, as well as other Canadian universities, finds through the pulp and paper industries a broad field of employment for graduates in engineering, chemistry and related sciences.

DISCUSSION

PERCEPTUAL DISORIENTATION DURING LANDING OF AIRPLANE

IN October, 1937, when making a plane trip to Texas, I had a striking experience in disorientation. During the intervening three years, despite frequent recitals of the experience, I have found but one other plane passenger who has observed the phenomenon. The phenomenon, as occurring in the airplane setting, is unknown to several psychologists who have been approached. It is likewise new to several aeronautical experts who have been told of it—including the pioneer, William B. Stout.

An opportunity to check the experience came on October 6, 1940. It faithfully repeated. Only the second episode need be related here. This second experience took place while using a TWA plane from Cincinnati to Detroit—a daytime trip in clear, sunny weather. I sat alone, facing forward, in a front left-side seat, next to the window. There were no passengers across the aisle, and I thus had a clear view through the right-side windows also.

The plane came down to make the Dayton Airport stop. As it levelled off, the disorientation phenomenon faithfully repeated itself. That is, after the plane has come down to the edge of the field, and has started to skim along the runway, the phenomenon begins. Looking out of the left window (with my face against it) the level field appeared as it should appear—horizontal. Glancing quickly across the aisle to look at the field through the right windows, the field was not as it should be: it appeared to slope down forward at an angle of about 15 degrees.

For the next 2,000 or 3,000 feet of travel, while the plane flew (or later rolled) along the runway, I rapidly looked back and forth eight or ten times. In spite of knowing perfectly well that the ground on one side was a continuation of that on the other, and in spite of these rapid and repeated opportunities to compare the ground on the two sides, the ground to the left remained horizontal, and that to the right persisted with its forward downhill slope.

When the plane, with a low remaining speed, wheeled through a short turn to taxi back, the phenomenon abruptly ceased.

The explanation offered below finds approval among the psychologists approached so far. With my face against my left window, the frame of my window is too far beyond my angle of vision to be allowed to act as a frame of reference. Thus, as long as the plane does not go into acrobatics, and sticks to minor lateral shifts or makes gentle glides to airports, I am given a full chance to reorient the ground and agree with myself that it is still horizontal.

But in looking across the aisle, a different story is presented. In level flight, the fuselage of the plane is for a long time approximately horizontal; also, the window frame lines are then horizontal and vertical. In particular, the eye has observed that the top and bottom window frame lines are parallel with the horizon.

Then, after the plane has changed its angle for landing, the fuselage is tilted upward by perhaps 15 degrees. One's intelligence therefore tells him that the ground is still horizontal, and that it is the window lines that have tilted upward. But the illusion takes charge and remains in charge. The window lines, which had been horizontal, continue to seem horizontal; the ground takes the blame, and seems to slope. The effect remains until the plane stops, or makes a turn at the end of the runway.

For the passenger, this is just another curious psychological experience; but it is conceivable that for the pilot, it might on occasion mean disaster. In landing by instruments, instruments can fail; and a daylight visual landing might have to be made. What then? It may be that with all plane designs ever produced up to now, the pilot can remain free from the effect. But some new design, perhaps combined with incidental shutting off of forward vision by frost or oil on the windshield, might place the pilot under the necessary conditions. Resulting confusion could have serious results.

Until some one makes tests, it would seem that to avoid the trouble, cockpit windows should have curved frames, rather than rectangular. This suggestion grows out of what one sees from the left-side window of the incident described. In addition to seeing the ground, a large part of my visual field was filled with a view of the wing and the nacelle. Obviously, these parts did not cause disorientation, even though they, like the right-hand window frames, had changed angle with respect to the ground. These parts present only curved outlines. Therefore, it may be that with all frame-of-reference lines curved, the disorientation would not occur.

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FROST RINGS IN LONGLEAF PINE

"FROST rings," abnormal zones of parenchymatous wood resulting from freezing temperatures during the growing season, are of common occurrence in northern and western trees.[1] To the writer's knowledge, however, their occurrence in longleaf pine (*Pinus palustris* Mill.) has not been previously reported.

Increment cores from second-growth stands of this species in southern Mississippi frequently have a conspicuous yellow- to tan-colored zone in the springwood of the 1932 ring. Microscopic examination shows the laterally displaced rays, distorted xylem elements and short-celled parenchyma that characterize frost injury. Weather Bureau records for Mississippi report the February of 1932 as the "warmest February in the records of this section beginning in 1888." The mean monthly temperature was 59.1° F., nearly 10 degrees higher than normal. This exceptionally warm period was followed by temperatures of 20° to 24° throughout southern Mississippi on March 9 and 10.[2]

Generally the injury is found in the beginning of the second or third ring from the pith, since usually only the 1- or 2-year-old shoots were affected. From 0 to 12 rows of normal springwood cells may intervene between the end of the 1931 growth and the frost ring, indicating the extent of growth previous to the period of freezing weather.

The malformation is present at breast height in most of the trees small enough to have been affected. Since second-growth longleaf is often marked by "false" rings and extremely narrow rings resulting from fire, the presence of a distinctive ring caused some years ago has been of service in growth measurements.

EARL L. STONE, JR.

SOUTHERN FOREST EXPERIMENT STATION

THE SUPERVISION OF PUBLICATION

DR. ATHERTON SEIDELL, writing in SCIENCE,[1] finds some fault with the distribution of scientific contributions among scientific workers in view of the difficulty and expense to which the worker is put in obtaining for his study the articles in which he is interested.

Dr. Seidell tries to criticize constructively, for he offers a recommendation for the solution of the problem:

> It is evident [he states] that a complete reorganization of the present system of publishing the results of scientific investigation is needed. Toward this end an advisory council on publication should be organized in each country for the purpose of studying the existing periodicals and defining more precisely the character of the contributions to be published in each. A system of routing the original communications in accordance with the field covered by each journal should also be established. The more highly specialized periodicals produced in this manner would enable the subscribers to receive more papers in which they are interested and fewer on subjects with which they are not concerned. The individual research worker would find it to his advantage to subscribe to them, and the cost of their publication would thus be distributed to an increasing extent among those for whose special benefit they are produced. *The supervision of publication by a central agency in each country would probably result in the elimination of some journals* [italics mine *sic*] and avoidance of the many changes in character, policy, title, size, price, etc., in others which now so greatly complicate the collection and maintenance of complete sets of periodicals by libraries and the task of making bibliographic searches in them.

Dr. Seidell, now with the U. S. Public Health Service, and for forty years on the payroll of the government, describes the scheme one would expect of a Totalitarian State or the U. S. S. R. What is the country coming to when its servants in high places propose "central agencies" for sorting and distributing the "contributions of the workers" and "eliminating some journals" for the "advancement of science and the public welfare"? How about the public welfare being served by individual enterprise and the freedom of the press? Give me the horse-and-buggy days, and leave for Europe the advancement of State Socialism.

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[1] A. S. Rhoads, *U. S. Dept. Agr. Bull.* 1131. 1923.

[2] U. S. Weather Bureau, Climatological Data, Mississippi Section, February, March, 1932.

[1] SCIENCE, 92: 345, 1940.

RICHARD L. SUTTON, JR.

KANSAS CITY, MO.

THE PLANNING COMMITTEE OF THE VIRGINIA ACADEMY OF SCIENCE

THE Virginia Academy of Science, with its thousand members from all fields of science and from prominent lay groups in the state, is to have a long-range planning committee to help make its usefulness to the state and nation more effective in these defense times and in the future. In addition, this committee will have a group of prominent Virginians as consultants, their names to be announced later.

The personnel of the long-range planning committee appointed by Wortley F. Rudd, president of the academy, follows:

Arthur Bevan, state geologist; L. C. Bird, president of Phipps and Bird, Inc.; Raymond B. Bottom, publisher of the *Daily Press* and *Newport News Times Herald*; Dr. Julian A. Burruss, president of the Virginia Polytechnic Institute; Francis S. Chase, executive secretary of the Virginia Education Association; Justus H. Cline, chairman, board of directors of the Virginia Wildlife Association; Virginius Dabney, editor of the *Richmond Times-Dispatch*; Dr. Frank A. Geldard, professor of psychology, University of Virginia; Dr. Meta Glass, president of Sweet Briar College; Dr. Sidney B. Hall, state superintendent of public instruction; Dr. William R. Harlan, assistant director of research, American Tobacco Company; Dr. J. Shelton Horsley, surgeon; W. Catesby Jones, chief chemist, State Department of Agriculture; Dr. Ivey F. Lewis, dean of the University of Virginia; H. K. McConnell, vice-president, Tobacco By-Products and Chemical Corporation; Robert F. Nelson, publicity director for the Virgina State Chamber of Commerce; Dr. Garnett Ryland, head of the department of chemistry, University of Richmond; R. M. Sanford, assistant director of the State Planning Board; Dr. I. A. Updike, head of the department of chemistry, Randolph-Macon College, with other officers of the academy besides Dean Rudd and E. C. L. Miller as *ex-officio* members; Dr. George W. Jeffers, president-elect and professor of biology at Farmville State Teachers College, and Dr. Sidney S. Negus, head of the department of chemistry, Medical College of Virginia.

This long-range planning committee will soon have its organization meeting and begin considering various scientific problems of Virginia which have been suggested during a comprehensive survey extending over the last four months and just completed. Some 1,200 persons were consulted by the president of the academy in this survey.

E. C. L. MILLER,
Secretary-Treasurer

SCIENTIFIC BOOKS

THE THEORY OF PROBABILITY

Theory of Probability. By HAROLD JEFFREYS. Oxford: published by the Clarendon Press. 1939.

THE purpose of this book is to construct a foundation for scientific method and to analyze inductive reasoning. The problem is attacked with the aid of the theories of probability and statistics. The author gives a set of postulates for the theory of probability. These postulates specify certain relations between implication and probabilities and demand that probabilities shall constitute a completely ordered set. Probabilities are interpreted as "degrees of reasonable belief" and are distinguished from the numbers which represent them. Number is introduced by means of two conventions and one additional postulate. These conventions do not require that certainty be represented by the number one. In fact on occasions the author finds it convenient to represent certainty by infinity. On the basis of the postulates and the conventions the usual results of the theory of probability are derived. The author discusses estimation problems and significance tests with the aid of Bayes's principle and the following rules: "If the parameter may have any value in a finite range, or from $-\infty$ to $+\infty$, its prior probability should be taken as uniformly distributed. If it arises in such a way that it may conceivably have any value from 0 to ∞, the prior probability of its logarithm should be taken as uniformly distributed." He devotes considerable attention to the justification of these rules. The latter part of the book is concerned with general questions, including a discussion of the frequency theory and other foundations for the theory of probability.

Let us note that science and indeed all inductive thinking are vitally concerned with predictions. The first few pages of this book furnish a strong support for this claim. In the pages which follow Jeffreys develops methods for estimating our degrees of belief in such predictions, but he fails to show how these degrees of belief are related to the successes and failures (or anticipated successes and failures) of the predictions. This neglect is characteristic of those who interpret probabilities in terms of mental states. In fact, the objection to such an interpretation is that it tends to conceal this fundamental problem. This problem is important. For if degrees of belief should give no adequate characterization of anticipated successes and failures, then they could have no important connection with such successes and failures. Perhaps this seems trivial, but it readily follows that without such characterization degrees of belief would be of no importance in science or inductive thinking. Fortunately, however, it is possible to obtain a consistent non-trivial characterization of probabilities in terms of anticipated successes and failures. I have done this in an article published in *Erkenntnis*. In view of this possibility the above objection would not be serious if it were not for two additional difficulties. First, my characterization was accomplished with the aid of the statistical theory to which the author violently objects and, second, the failure to consider the question which I have raised has led to some very questionable reasoning in connection with the representation of certainty by infinity. It is of course conceivable that one could develop a theory of probability which was based on such an infinite scale and which contained a connection between probabilities and results. However, the author has not done this. Furthermore, in some applications of Bayes's principle he has used two different scales in the same problem without any interpretation or justification of the procedure. Thus in the case of problems of estimation we are left with formulas based on very doubtful prior probabilities. If this were the best we could do, we should have to be content. But Fisher and Neyman have developed corresponding formulas which are independent of the prior probabilities.

The author has tackled a problem which has previously received too little attention and much is to be gained by following his treatment of the subject. Thus my criticisms should be taken simply as indicating points that need further attention. The book is indeed a contribution to the advancement of science.

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EUGENICS

Preface to Eugenics. By FREDERICK OSBORN. 312 pp. New York: Harper and Brothers, 1940. $2.75.

THE preface to eugenics is the set of principles and practices that must be adopted before "a eugenic form of society will be possible" (p. 260). This set includes: birth control, "equal opportunities for development open to all children everywhere." "Children have the right to be born to parents who will care for them properly. Children have the right to be born free of the more serious hereditary defects." The book under review is largely an elaboration of these points.

There are seven chapters. The first refers to chromosomes and genes, human variability and the need of improvement of the racial stock. The second is a keen and sound study of the hereditary and environmental factors in the psychological sphere. This is largely the work of Dr. Gladys Schwesinger. Chapters 3 and 4 deal chiefly with population and are largely quantitative; but reference is made to relative fecundity of whites and Negroes and that of various socio-economic groups. Chapter 5 deals with eugenic selection under the influence of a favorable environment and stresses the importance of birth control and especially the desirability of the reduction of births among those least responsive to the possibilities of their environment and the increase of births among parents who are most responsive. The author does not discuss the craving for children that exists among certain middle-class women like the mother of President Harding, who had eight children and stated that she wished she had had more. On the other hand, just as in Rome great prosperity resulted in reduction of fecundity among the "higher" classes, so prosperity seems to act in the United States. No subsidy would alter their attitude. Chapter 6 deals with the psychological aspects of a eugenical environment. This cites from Dr. Margaret Mead the case of two primitive peoples in one of whom the children are handled gently by the parents and become gentle; in the other the children are handled roughly and grow into hard and aggressive adults. The possibility that there is a genetic thread running through the generations that may be partly responsible for the difference is not discussed. In geese, living in flocks, the parental instinct herds the young from infancy and when they in turn become parents they herd their young. Is this merely a transmission of a tradition, or is there an hereditary factor? The author states that the ideal of equalizing educational opportunities in the United States has never been fully attained. He does not discuss the possibility that the inequality of opportunity is partly due to the inequality of the children for taking advantage of it. The author finds that the atmosphere of colleges and graduate schools is generally unfavorable to marriage. Perhaps there is a selection here such that the more marriageable are married before they get to the graduate schools. If, as the author concludes, "parents who want no more children should be helped not to have them, and parents who want children should in most cases be helped to have them" then the career-seeking and the prosperous, the ambitious and educated would have even fewer children and the group at the opposite socio-economic scale would have more of them. A feebleminded girl discharged from a state institution had 14 children, perhaps because she wanted them.

As a whole, the book is well and interestingly written. The principal criticism might be that the author tends to make generalizations which are the result of his profound conviction and reasoning, but for which the factual basis is often not given. Of the high idealism of the author there can be no doubt, but as to whether we should wait for the completion of the preface before beginning education in regard to mate selection and inheritance of traits there may well be a difference of opinion, and to many students the preface to the Preface would be more research.

CHAS. B. DAVENPORT

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THE NATIONAL ACADEMY OF SCIENCES

ABSTRACTS OF PAPERS

(Continued from page 468)

Orthogonal polynomials and closure: JAMES A. SHOHAT (introduced by L. P. Eisenhart). The following two results are established: (1) If closure holds for a symmetric system of orthogonal polynomials (OP), it also holds for property related non-symmetric systems of OP, and *vice versa.* Illustration: the polynomials of Hermite and Laguerre. (2) If the remainder in Parseval Formula, applied to a given $f(x)$, is $O\left(\frac{1}{\log^{2+\epsilon} n}\right)$, with some $\epsilon > O$, then the expansion of $f(x)$ in a series of OP under discussion converges almost everywhere in the orthogonality interval (a, b), assumed to be finite. This yields very general criteria of convergence, in particular, for continuous functions.

General invariants of irregular curves: EDWARD KASNER. The general group of analytic transformations is applied to curves expressed in fractional power series. Some types have invariants, some have not. This presents a new aspect of restricted topology. An extensive complete classification has been obtained with the collaboration of J. De Cicco.

A supplement to Ramanujan's identities: HANS RADEMACHER (introduced by L. P. Eisenhart). S. Ramanujan gave two identities which make evident certain divisibility properties of the number of partitions $p(n)$. If these identities are written in terms of the Dedekind function $\eta(\tau)$ they can be subjected to modular transformations. In this way we obtain new identities, which are noteworthy because of the occurrence of the Legendre symbol.

The evolution of a peculiar stellar spectrum: Z Andromedae: OTTO STRUVE and P. SWINGS. The new 82-inch telescope of the McDonald Observatory has been devoted, during the past year, to a study of a relatively small group of peculiar stars whose spectra can not be fitted into the continuous sequence of normal stellar spectra. One of the most remarkable members of this group is the variable star, Z Andromedae. It was discovered as an irregular star of variable brightness in 1901 and it was early suspected to be subject to eruptions similar to those of a nova. The latest eruption took place a year ago, with an increase in brightness from magnitude 10.7 to magnitude 7.9. Since then the brightness has slowly declined. This eruption was accompanied by changes in the spectrum. Near maximum light the spectrum was that of a P-Cygni type star showing lines of relatively low excitation (Fe II, Ti II, etc.), displaced toward the violet by amounts corresponding to velocities of expansion between 100 and 60 km/sec. Since the early summer of this year the spectrum has taken on an entirely different character. We recognize essentially four distinct sources of light: (*a*) a hot star presenting some of the characteristic features of Wolf-Rayet stars; (*b*) a cool, M-type, giant star forming a binary system with the hot star; (*c*) a tenuous nebula giving rise to forbidden and permitted emission lines of [O III], O III, [Ne III], [Ne V]; this nebula probably surrounds the binary system; (*d*) remnants of an expanding shell giving rise to a P-Cygni type spectrum of H, He I, Fe II and to emission lines of Mg II, Si I, Si II, Ti II, Fe I and [Fe II]. The occurrence of irregular violent outbursts in a binary system is of special interest. They are probably responsible for the enveloping nebula and for the disappearing spectrum of the expanding shell. The latter is remarkable because of the exceptional strength of the so-called forbidden auroral transition of [O III] at λ 4363. This line is also strong in several other binary systems of similar type, namely, in T Coronae, AX Persei, CI Cygni, RW Hydrae, etc. The effect is interpreted as a consequence of high electron density in the nebula—a phenomenon which we have also observed in the planetary nebula IC 4997. Z Andromeda bears a certain resemblance to the famous variable Mira Ceti, in which the hot binary companion is a variable emission-line star of spectral class B, and to Antares, whose hot companion is surrounded by a small nebulosity which exhibits forbidden lines of [Fe II]. It is exceedingly probable that the close association of a cool giant star with a compact, hot companion results in disturbances which we observe as eruptions, and which produce a succession of spectroscopic anomalies: an outburst of the surface layers of one of the two components, the gradual dissipation of the exploded material and, finally, the creation of a nebula surrounding the entire system.

Orbital motion in the multiple system Sigma Coronae Borealis: PETER VAN DE KAMP and JANET M. DEVILBISS (introduced by O. E. McClung). A twelfth magnitude star sharing the proper motion of the well-known visual binary Sigma Coronae Borealis was discovered a year ago on plates taken with the twenty-four-inch refractor of the Sproul Observatory. The positions of the distant companion (*c*) and of the two components of the classical pair (*A*,*B*) were measured on 29 plates taken on 22 nights since 1916. The resulting relative motions were reduced to a reference frame of thirty-five faint stars. The relative proper motion of the faint companion *c* with respect to the center of a mass of *A* and *B* amounts to +″.0004 ±″.0023 in right ascension and +″.0101 ±″.0023 in declination; the errors include the accidental errors of observation and of the inertial system. Compared with the total motion (0″.29) of the system *A*,*B* the relative motion of *c* and *AB* is small enough to leave little doubt about the physical connection of *c* with *AB*. Interpreted as orbital motion, it is direct (counterclock wise), as is the relative *motion of B and A. The separation of c from the center* of mass of *A* or *B* is 632″.74 in position angle 241°6′48″ (2000 equator). The yearly increase in position angle is 2″.8; the direction of the relative motion differs 59° from the radius vector, which at present appears to be decreasing. With a parallax of ″.048 (distance 68 light years) the projected linear separation is 13,000 astronomical units. In Sigma Coronae Borealis one thus finds a *quadruple* system, representing the widely different periods of eight days for the spectroscopic system A, about 1,200 years for the visual system *A*,*B*, and a period of the order of a million years for the motion of *c* around *AB*.

Some galactic explorations in the southern hemisphere: HARLOW SHAPLEY. The metagalactic survey of the southern sky, which is being carried on with the aid of the staff and various telescopes of the southern station of the Harvard Observatory at Bloemfontein, in the Orange Free State, has brought to light many interesting or peculiar objects not heretofore known. Among the items discussed are the following. (1) A new Magellanic Cloud in Phoenix, only twenty degrees from the South Galactic Pole, which is probably of dwarf galaxy type, at a distance of not less than a million light years. (2) Further exploration of the wing to the Small Magellanic Cloud that points in the direction of the Large Cloud and helps to establish the hypothesis that the Large and Small Clouds are a true double system. (3) A new globular cluster that possibly lies between our Galaxy and other members of the local group of galaxies. (4) A region in high galactic latitude that is devoid of faint variables and which indicates therefore the irregularities in the structure of the star haze surroundng our galactic system. (5) A peculiar streak nebula in the southern Milky Way that is somewhat similar to the well-known Veil Nebula in Cygnus. Not heretofore recorded, it is now found on several long-exposure plates, some of which show that its irregular arc is more than four degrees in length, and only about one thirtieth of a degree wide.

Quantum many-body problem: L. I. SCHIFF (introduced by D. W. Bronk). A method is developed to treat the quantum mechanical many-body problem at temperatures so low that degeneracy plays a dominant role. The inter-particle forces are taken into account in a manner analogous to the expension in virial coefficients of the equation of state of a non-ideal classical gas, while the degeneracy is always considered exactly. Thus the first term in the expansion gives an ideal Fermi-Dirac or Bose-Einstein gas, as the case may be, and not an ideal classical gas. The second term gives the correction due to two body encounters; it can be reduced to a set of quadratures if the wave-functions that describe the collisions of two particles are known. The method is now being applied to the phase transition in liquid helium, with the object of finding the nature of the deviations from London's free-particle model. It may also be useful in the theory of metals and of atomic nuclei.

A pragmatic approach to the elementary principles of wave mechanics: WILLIAM F. G. SWANN (introduced by D. W. Bronk). The paper proceeds by a route which does not involve, and has meaning apart from, the concept of charged particles. The starting concept is that of a state of a system, supposed defined by a function ψ of a number of variables, which for purposes of illustration is taken as 3. Two kinds of states are involved. We have states such as those of the hydrogen atom where there is nothing to be seen as associated with the state itself, and where the story of interest is in the transitions. Then we have states represented by what, in the ordinary descriptions of phenomena, correspond to such things as beams of electrons deflected in cathode ray oscillographs, but which in actuality present for observation beams of luminescence whose boundaries are to be associated with the boundaries between regions where ψ is zero and regions where it is finite. It becomes recognized that the shapes of such observable characteristics of a state can be described by a principle of least time, *with a suitable chosen velocity* μ, *varying from point to* point in such manner as to be proportional everywhere to $1/(E-V)^{1/2}$, where E is the potential difference which creates the beam, and V is the potential at a point between plates which deflect it, both being measured by voltmeters, for example. A recognition of the fact that a beam such as the foregoing can—in what are called electron diffraction experiments—become split into several beams suggests laws of interference such as demand periodic phenomena, and implies that the beams themselves are ray paths in a wave system governed by the velocity μ aforesaid. The ordinary diffraction experiments are usually regarded as establishing the law $\lambda = h/mv$, but confinement of attention to what is *observed* experimentally leads merely to a relation, $D \text{ Sin } \theta = sg/E^{1/2}$, where s is an integer, D is the grating space, θ is an angle of deflection appropriate to the experiment, and E is the voltmeter potential difference which created the beam. The essential gift of experiment is to reveal the constancy of $E^{1/2} \text{ Sin } \theta$ and so through the association of $D \text{ Sin } \theta$ for $s = 1$ with the wave-length λ, that quantity becomes determined as $g/E^{1/2}$ and the velocity μ for this case of zero V becomes determined in terms of the frequency ν as $\mu = g\nu/E^{1/2}$. Association of this result with the proportionality between μ and $1/(E-V)^{1/2}$ for the case where V is not zero leads to $\mu = g\nu/(E-V)^{1/2}$. With this μ

we write down a wave equation, and solving it for periodic solutions, we arrive at a Schroedinger equation from which ν has disappeared explicitly, and only the experimentally determined constant g remains. The equation then gives eigen-values proportional to $1/n^2$, where n is an integer, provided that V is taken of the form q/r, where q is any constant. If we associate the eigen-values with the excitation potentials W_n for hydrogen, we can determine the numerical value of q. Subsequent association with line spectra for hydrogen through the relation $\nu_{mn}=A(W_m-W_n)$ determines a new constant A, or, if we choose, a quantity h, defined by q/A. The electronic mass, m, makes no appearance at any point in a nonrelativistic formulation.

Experimental studies on the physiology of diving mammals: LAURENCE IRVING, P. F. SCHOLANDER and S. W. GRINNELL (introduced by M. H. Jacobs). Seals (*Phoca vitulina*), porpoises (*Tursiops truncatus*) and Florida manatee have been observed during experimental dives of 15, 3 and 15 minutes, respectively. Characteristics of external respiration were recorded on a respirometer showing ventilation, O_2 consumption and difference between CO_2 and O_2 exchange as a basis for examining the sequence of physiological adjustments in detail. The heart rate of seals decreases immediately after a dive to about 10 per cent. of its normal frequency and returns at once on emergence. The bradycardia in porpoises and manatee is not less than half normal. In the arterial blood O_2 is steadily depleted during a dive and exhaustion of O_2 marks the limit of a diving period. Lactic acid does not increase in the blood to any extent during the dive, but in the recovery period lactic acid floods the blood of seals and manatee, and its CO_2 content diminishes in proportion. Surprisingly little lactic acid was formed in porpoises. Periodic analyses of muscles during dive and recovery showed that the oxygen content, about 5 volumes per cent. before the dive, is almost completely reduced in five minutes, and is restored quickly in recovery. Lactic acid apparently increases little until the time when the myoglobin is reduced and then rises more rapidly to a maximum as great as 300 mg per cent. at the end. CO_2 content does not change in the dive, but diminishes after recovery starts, when lactic acid is still high in the muscles and is appearing in large quantities in the arterial blood. The abdominal temperature remains constant during a dive, but the muscle temperature decreases. In recovery the abdominal temperature drops. The temperature changes indicate diminished provision of heat to the peripheral muscles. Blood flow in the muscles, as indicated by an electrically heated resistance wire type of meter, diminishes promptly in the dive and recovers immediately after. Indications are for sustained flow through the brain. The combined observations fit a scheme of adjustment to diving in which blood flow decreases through the muscles, which are maintained at first by utilizing their intrinsic oxygen reserves, followed by resort to anaerobic formation of lactic acid. The small part of the circulation which is still maintained during the dive provides prolonged aerobic metabolism for a selected part of the tissues, and when the oxygen available from blood is expended the diving capacity is at an end.

Collection and analysis of fluid from single glomeruli and tubules of the mammalian kidney: ARTHUR M. WALKER and JEAN R. OLIVER (introduced by A. N. Richards). This investigation represents an extension to the mammalian kidney of the type of experimentation employed by Richards and his collaborators on the amphibian kidney. Certain technical difficulties having been overcome, it became possible to visualize tubules and glomeruli upon the surface of eviscerated anesthetized guinea pigs and opossums, to cannulate these units with a quartz pipette, and to collect sufficient fluid from them for quantitative analysis of protein, glucose and total molecular concentrations by ultramicro methods. The portion of the tubule from which fluid was collected was precisely identified by the maceration technique of Oliver. A series of thirty experiments has been completed. The results prove that glomerular fluid has the same glucose and total molecular concentrations as blood plasma and usually contains no protein, that glucose is reabsorbed by the proximal tubule, and that the total molecular concentration of tubule fluid does not rise until the proximal segment has been passed. These results are analogous to the localization of function which has been demonstrated in amphibia.

Relative overgrowth of the central nervous system in vitamin A deficiency in young animals: S. B. WOLBACH and OTTO BESSEY. Vitamin A deficiency in young animals (rats, guinea pigs, dogs) if established early, during the period of greatest growth rate, has as one of its striking consequences injury to the nervous system involving sensory and motor functions. The explanation has been found to be overgrowth of the central nervous system in relation to its bony enclosure, resulting in mechanical damage to brain, spinal cord and nerve roots. Our studies have been made chiefly upon white rats. In this animal the gross manifestations of the growth differential established by the deficiency are: (1) overcrowding of the cranial cavity with distortion of the brain, shown by dislocation toward the foramen magnum and extrusion of the cerebellum and cerebrum into the venous sinuses of the dura at the sites of arachnoidal villi; (2) overcrowding of the spinal canal with distortion of the caudal end of the spinal cord and herniation of nerve roots into the intervertebral foramina and into the bodies of vertebrae; (3) resorption of bone of the cranium and bodies of the vertebrae due to pressure. In the latter location deep pits, symmetrically situated and occupied by coiled nerve roots, are formed. In rats the unequal growth of bone and nervous system occurs between the fortieth and sixtieth days of age, a period in the deficiency when weight increase has been but little retarded. If vitamin A (in the form of carotene) is added to the diet at 42 days of age and the diet restricted in amount so that the growth parallels litter-mates in continued vitamin A deficiency, none of the effects described above takes place. On postmortem examination at sixty-three days of age, the rats given carotene show no, or very slight, anatomical changes in the central nervous system, in contrast to the striking lesions found in the litter-mates maintained on the deficiency for the entire period. Growth of bone eventually ceases in vitamin A deficiency and this fact must enter into the explanation of the effect described. However, the study of rats whose growth has been retarded at an equal rate and degree—(1) through inadequate diet with full vitamin complement and (2) through riboflavin deficiency—showed normal relations of nervous system to skeleton. Guinea pigs in general responded to the deficiency, as did rats. One experiment with dogs indicates that the maximum effect in this animal will be found in cranio-cerebral relations. We are unable to explain satisfactorily this disproportionate growth established in young animals by vitamin A deficiency. In order to evaluate data on hand, a more complete knowledge of the growth sequences of the skeleton of the rat must be obtained. We are convinced that vitamin A deficiency does not retard the growth of the nervous system. Our studies thus far suggest that the most important consequence of vitamin A deficiency upon growth of the skeleton is upon those sequences concerned in the substitution of bone for cartilage—*i.e.*, endochondral growth of bone. Unretarded growth of the central nervous system and disturbances in initiation and development of centers of ossification are the two obvious factors to be considered in the search for an explanation of the effects we have described. These two factors, when considered in relation to normal growth sequences and anatomical differences of the several species exhibiting lesions of the central nervous system in consequence of A deficiency, may possibly explain the different effects thus far described in rats, dogs and calves.

(*To be concluded*)

REPORTS

THE NATIONAL DEFENSE RESEARCH COMMITTEE

DR. VANNEVAR BUSH, chairman of the National Defense Research Committee, has made public a list of scientific men and engineers who have thus far accepted definite appointments to work with the committee. The committee will deal with particular problems as they arise. Further appointments will be made as rapidly as effective use can be made of additional individuals in the solution of specific problems.

Created by order of the Council of National Defense on June 27, the National Defense Research Committee consists of the following eight members:

Vannevar Bush, *Chairman*, president, Carnegie Institution of Washington.
Richard C. Tolman, *Vice-Chairman*, dean of the Graduate School, California Institute of Technology.
H. G. Bowen, Rear Admiral.
Conway P. Coe, Commissioner of Patents.
Karl T. Compton, president, Massachusetts Institute of Technology.
James B. Conant, president, Harvard University.
Frank B. Jewett, president, National Academy of Sciences; chairman of the Board of Bell Telephone Laboratories.
G. V. Strong, Brigadier General.

The secretary of the committee is Dr. Irvin Stewart, director of the Committee on Scientific Aids to Learning.

Dr. Bush, as chairman, is coordinating the work of the committee with that of other governmental and private agencies and is maintaining direct supervision over a limited number of problems. General Strong and Admiral Bowen are responsible for the maintenance of close working relationships between the committee and the military services. Commissioner Coe is in charge of matters relating to inventions and patents and provides a direct connection between the committee and the National Inventors Council.

Dr. Tolman is chairman of the division dealing with armor and ordnance, Dr. Conant of the division dealing with chemical problems, Dr. Jewett of the division dealing with communication and transportation, and Dr. Compton is in charge of the work on detection, controls and instruments.

Professor Charles C. Lauritsen, of the California Institute of Technology, is vice-chairman of the division concerned with armor and ordnance. Those who have already accepted appointments to work on problems with which that division deals include:

P. H. Abelson, Carnegie Institution of Washington.
Samuel K. Allison, University of Chicago.
Ralph D. Bennett, the Massachusetts Institute of Technology.
Robert A. Becker, California Institute of Technology.
L. V. Berkner, Carnegie Institution of Washington.
Walker Bleakney, Princeton University.
John E. Burchard, the Massachusetts Institute of Technology.
Donald S. Clark, California Institute of Technology.
R. H. Crane, University of Michigan.
J. A. Fleming, Carnegie Institution of Washington.
Wm. A. Fowler, California Institute of Technology.
Ralph E. Gibson, Carnegie Institution of Washington.
R. H. Goddard, Clark University.
George Kenneth Green, Carnegie Institution of Washington.
L. R. Hafstad, Carnegie Institution of Washington.
C. N. Hickman, Bell Telephone Laboratories.
J. C. Hubbard, the Johns Hopkins University.
Emory Lakatos, Bell Telephone Laboratories.
R. C. Meyer, Carnegie Institution of Washington.
R. B. Roberts, Carnegie Institution of Washington.
H. P. Robertson, Princeton University.

H. D. Smyth, Princeton University.
John F. Streib, Jr., California Institute of Technology.
John T. Tate, University of Minnesota.
M. A. Tuve, Carnegie Institution of Washington.

Professor W. K. Lewis, of the Massachusetts Institute of Technology, and Professor Roger Adams, of the University of Illinois, are serving as vice-chairmen, under Dr. Conant, of the division dealing with chemical problems. Among those who are working with that division are the following:

Homer Adkins, University of Wisconsin.
W. E. Bachmann, University of Michigan.
J. C. Bailar, Jr., University of Illinois.
G. P. Baxter, Harvard University.
Henry Bent, University of Missouri.
Wm. Crowell Bray, University of California.
Weldon Grant Brown, University of Chicago.
Arthur M. Buswell, University of Illinois.
H. M. Chadwell, Tufts College.
E. W. Comings, University of Illinois.
G. O. Curme, Jr., the Carbide and Carbon Chemicals Corporation.
Farrington Daniels, University of Wisconsin.
Tenney L. Davis, the Massachusetts Institute of Technology.
B. F. Dodge, Yale University.
R. C. Elderfield, Columbia University.
J. C. Elgin, Princeton University.
Henry Eyring, Princeton University.
W. C. Fernelius, the Ohio State University.
L. F. Fieser, Harvard University.
Wm. Francis Giauque, University of California.
Henry Gilman, the Iowa State College.
C. S. Hamilton, University of Nebraska.
Henry B. Hass, Purdue University.
A. L. Henne, the Ohio State University.
Carroll Hochwalt, the Monsanto Chemical Company.
T. R. Hogness, University of Chicago.
Charles R. Hoover, Wesleyan University.
O. L. Hougen, University of Wisconsin.
C. C. Hurd, Northwestern University.
J. R. Johnson, Cornell University.
W. C. Johnson, University of Chicago.
H. F. Johnstone, University of Illinois.
F. G. Keyes, the Massachusetts Institute of Technology.
Morris S. Kharasch, University of Chicago.
Walter Raymond Kirner, Carnegie Institute of Technology.
G. B. Kistiakowsky, Harvard University.
Izaac M. Kolthoff, University of Minnesota.
C. A. Kraus, Brown University.
Victor LaMer, Columbia University.
Irving Langmuir, General Electric Company.
W. M. Latimer, University of California.
P. A. Leighton, Stanford University.
W. H. McAdams, the Massachusetts Institute of Technology.
W. L. McCabe, Carnegie Institute of Technology.
Duncan MacInnes, Rockefeller Institute.
C. S. Marvel, University of Illinois.
Thomas Midgley, Ethyl Gasoline Corporation.
C. R. Noller, Stanford University.
W. A. Noyes, Jr., the University of Rochester.
Linus Pauling, California Institute of Technology.
G. A. Richter, Brown Company.
W. H. Rodebush, University of Illinois.
W. C. Schumb, the Massachusetts Institute of Technology.
T. K. Sherwood, the Massachusetts Institute of Technology.
J. H. Simons, Pennsylvania State College.
G. B. L. Smith, Polytechnic Institute of Brooklyn.
George F. Smith, University of Illinois.
L. I. Smith, University of Minnesota.
Reston Stevenson, the City College of New York.
Charles A. Thomas, Monsanto Chemical Company.
Victor Howard Turkington, Bakelite Corporation.
E. S. Wallis, Princeton University.
Archie James Weith, Bakelite Corporation.
Albert Easton White, University of Michigan.
F. C. Whitmore, Pennsylvania State College.
Hobart H. Willard, University of Michigan.
E. B. Wilson, Jr., Harvard University.
M. L. Wolfrom, the Ohio State University.
J. H. Yoe, University of Virginia.
Don M. Yost, California Institute of Technology.

Assisting Dr. Jewett are three vice-chairmen—Dr. C. B. Jolliffe, of the Radio Corporation of America, in charge of communications; Hartley Rowe, of the United Fruit Company, in charge of transportation, and R. D. Booth, of the engineering firm of Jackson and Moreland, in charge of electrical and mechanical problems. Those who are assisting in the work of that division include the following:

Harry L. Bowman, Drexel Institute of Technology.
O. E. Buckley, Bell Telephone Laboratories.
Hallowell Davis, Harvard University.
J. H. Dellinger, National Bureau of Standards.
W. L. Everitt, the Ohio State University.
Harvey Fletcher, Bell Telephone Laboratories.
J. A. Hutcheson, Westinghouse Electric and Manufacturing Company.
L. F. Jones, Radio Corporation of America.
Vern O. Knudsen, University of California.
Frank H. Moore, formerly with the Tennessee Valley Authority.
A. F. Murray, consulting television engineer.
Haraden Pratt, Mackay Radio Company.

Dr. Alfred L. Loomis, of the Loomis Laboratories, is vice-chairman of Dr. Compton's division. Those assisting in the work of that division include the following:

Walter S. Adams, Mount Wilson Observatory.
Kenneth T. Bainbridge, Harvard University.
R. R. Beal, Radio Corporation of America.
Harold H. Beverage, Radio Corporation of America.
E. L. Bowles, the Massachusetts Institute of Technology.
Ralph Brown, Bell Telephone Laboratories.

S. H. Caldwell, the Massachusetts Institute of Technology.
E. U. Condon, Westinghouse Electric and Manufacturing Company.
Donald Cooksey, University of California.
C. S. Draper, the Massachusetts Institute of Technology.
E. W. Engstrom, Radio Corporation of America.
W. C. Evans, Westinghouse Electric and Manufacturing Company.
T. C. Fry, Bell Telephone Laboratories.
L. O. Grondahl, Union Switch and Signal Company.
William W. Hansen, Stanford University.
G. R. Harrison, the Massachusetts Institute of Technology.
Thomas H. Johnson, Franklin Institute.
M. J. Kelly, Bell Telephone Laboratories.
Paul Klopsteg, Central Scientific Company.
Ernest O. Lawrence, University of California.
Frank D. Lewis, Loomis Laboratories.
George Metcalf, General Electric Company.
J. P. Molnar, the Massachusetts Institute of Technology.
Philip McCord Morse, the Massachusetts Institute of Technology.
Edward J. Poitras, the California Institute of Technology.
Louis A. Turner, Princeton University.
Warren Weaver, Rockefeller Foundation.
H. Hugh Willis, Sperry Gyroscope Company.
C. L. Wilson, Research Corporation.

Serving on committees reporting directly to the chairman or otherwise assisting the chairman are the following:

J. W. Beams, University of Virginia.
Gregory Breit, University of Wisconsin.
Lyman J. Briggs, director, National Bureau of Standards.
T. H. Dillon (Colonel), Carnegie Institution of Washington.
Ross Gunn, Naval Research Laboratory.
John H. Howard, the Massachusetts Institute of Technology.
G. B. Pegram, Columbia University.
H. C. Urey, Columbia University.

Lloyd Sutton is serving on a Patent Advisory Committee with Commissioner Coe.

With the exception of six who have obtained leave of absence from their regular positions and who are devoting full time to the work of the committee, all have volunteered their services on a part-time basis without compensation. The committee has completed or has under negotiation approximately sixty contracts with industrial laboratories and universities for carrying out research on specific problems.

According to Dr. Bush, the scientists and engineers of the United States have been most enthusiastic in the offer of their services. In addition, they have understood that it is not possible on short notice to make the most effective use of the skill and talent of thousands of persons, and they have been sympathetic with the program of the committee in accepting the services of individual scientists only as problems were brought into a form where their talents could most effectively be used.

The task assigned to the committee by the Council of National Defense is that of correlating and supporting scientific research on mechanisms and devices of warfare. It does not extend to such matters as food or medicine and health. For that reason the men selected to aid the committee will continue to be drawn largely from the fields of chemistry, physics and engineering.

SPECIAL ARTICLES

THE LOGISTIC CURVE AND THE CENSUS COUNT OF 1940[1]

EARLY in 1920 Pearl and Reed[2] published the results of fitting a logistic curve to the census counts of the population of the United States from 1790 to 1910, inclusive. At the time the computations were made in 1919 the results of the census of 1920 were not available, and therefore were not and could not be included in the calculations. Soon after the original paper was published the notation was improved, and the curve took the definitive form, still, however, *without* the use of the 1920 count:

$$y = \frac{197.27}{1 + 67.32e^{-0.0313x}} \qquad (1)$$

where y denotes calculated population in millions, and x time, in base units of one year. This curve (1) will be hereinafter referred to as Logistic I. It is depicted graphically in Fig. 1 with the actual census counts of 1920, 1930 and 1940 (preliminary figure) inserted as crossed circles connected by a dash line to indicate that in the derivation of equation (1) no census count after that of 1910 was used.

Thirty years have elapsed since the last *datum* (the census count of 1910) available when the curve was calculated. It seems justifiable now to make a further examination of how the case goes, as was done in 1930.[3] The following tabulation gives the facts.

It thus appears that the forecast made by Logistic I missed the counted population by *16 parts in a thousand* in excess in 1920; by *2.5 parts in a thousand* in defect in 1930, and by *37.3 parts in a thousand* in excess in 1940. The error in 1940 is of perhaps about

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[1] From the department of biology and the department of biostatistics (Paper No. 215) of the School of Hygiene and Public Health, Johns Hopkins University.

[2] R. Pearl and L. J. Reed, *Proc. Nat. Acad. Sci.*, 6: 275–288, 1920.

[3] R. Pearl and L. J. Reed, SCIENCE, 72: 399–401, 1930.

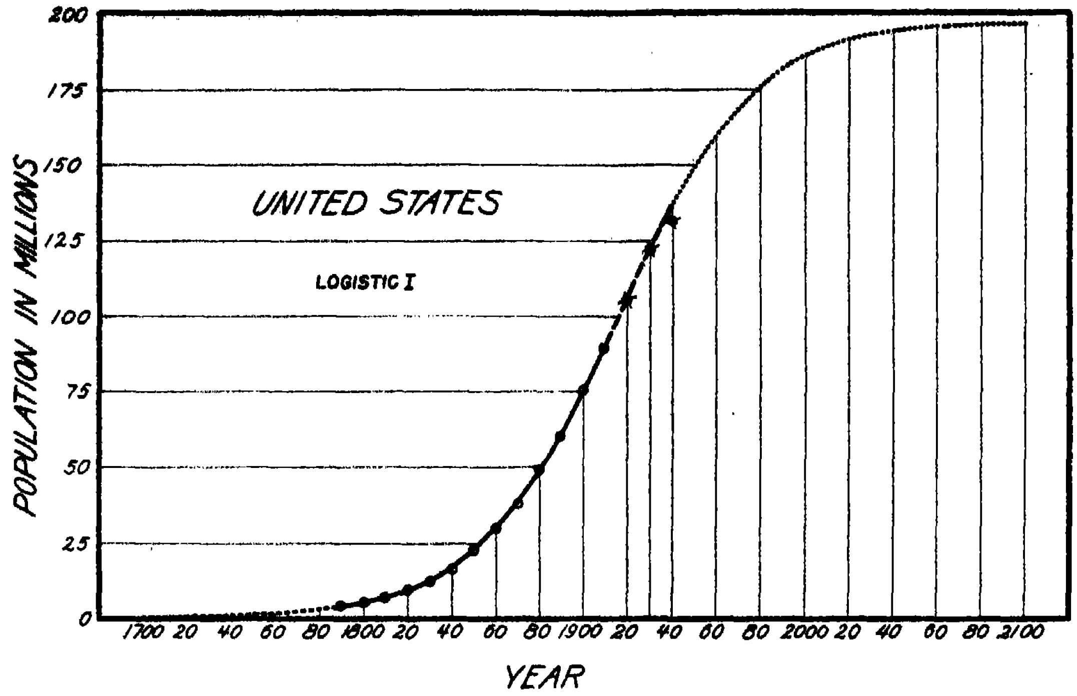

FIG. 1. The census counts of the population of the United States from 1790 to 1940, inclusive (given by circles). The smooth curve is the logistic of equation (1) fitted to the census counts from 1790 to 1910 inclusive. The broken lines show the extrapolation of the curve beyond the data to which it was fitted. The dash portion from 1910 to 1940 is the part of the extrapolation which has been tested by census counts (crossed circles) which have been made since the logistic was originally fitted. The dotted line shows the further extrapolation of the same curve.

TABLE I

POPULATION OF CONTINENTAL UNITED STATES (IN MILLIONS)

	A. As forecast by Logistic I (data of 1790–1910)	B. As counted by the Census Bureau
1920	107.4	105.7
1930	122.4	122.7
1940	136.3	131.4

the same order of magnitude as that probably inherent in the count itself. But it is considerably larger than that made by the curve in either 1920 or 1930.

In our earlier work with the logistic curve we have repeatedly emphasized (a) that it is a basic postulate of the logistic theory of population growth that any particular population can be expected to continue to follow in its later growth the same logistic curve that it has followed in its earlier growth *only* if there has been no serious or cataclysmic alteration of the conditions (climatic, geological, biological, economic or social) under which its earlier growth has taken place; and (b) that if, and when, evidence appeared that indicated that substantial alteration of the conditions of growth had occurred a new logistic should, and would, be derived to take into account the new evidence. The census counts of 1920 and 1930 indicated no such evidence. Does the count of 1940? We do

TABLE II

THE POPULATION OF THE UNITED STATES: (A) AS COUNTED IN OFFICIAL CENSUSES; (B) ACCORDING TO LOGISTIC II; (C) ACCORDING TO LOGISTIC I. (ALL POPULATIONS ARE IN *MILLIONS OF PERSONS*)

Year	A Observed	B Logistic II	C Logistic I	B–A	C–A
Lower asympt	....	.000	.000	....	....
1700	....	.210	.239	....	....
1720	....	.399	.446	....	....
1740	....	.758	.833	....	....
1760	....	1.438	1.553	....	....
1780	....	2.718	2.887	....	....
1790	3.929	3.730	3.929	− .199	.000
1800	5.308	5.108	5.336	− .200	+ .028
1810	7.240	6.974	7.228	− .266	− .012
1820	9.638	9.487	9.757	− .151	+ .119
1830	12.866	12.840	13.109	− .026	+ .243
1840	17.069	17.260	17.506	+ .191	+ .437
1850	23.192	22.997	23.192	− .195	.000
1860	31.443	30.294	30.412	− 1.149	− 1.031
1870	38.558	39.342	39.372	+ .784	+ .814
1880	50.156	50.209	50.177	+ .053	+ .021
1890	62.948	62.775	62.769	− .173	− .179
1900	75.995	76.684	76.870	+ .689	+ .875
1910	91.972	91.352	91.972	− .620	.000
1920	105.711	106.053	107.394	+ .342	+ 1.683
1930	122.775	120.054	122.397	− 2.721	− .378
1940	131.410	132.756	136.318	+ 1.346	+ 4.908
1950	......	143.779	148.678	....	....
1960	......	152.986	159.230	....	....
1970	......	160.430	167.945	....	....
1980	......	166.205	174.941	....	....
1990	......	170.820	180.437	....	....
2000	......	174.256	184.678	....	....
2020	......	178.751	190.341	....	....
2040	......	181.205	193.509	....	....
2060	......	182.522	195.249	....	....
2080	......	183.221	196.337	....	....
2100	......	183.590	196.681	....	....
Upper asympt	......	184.000	197.274	....	....

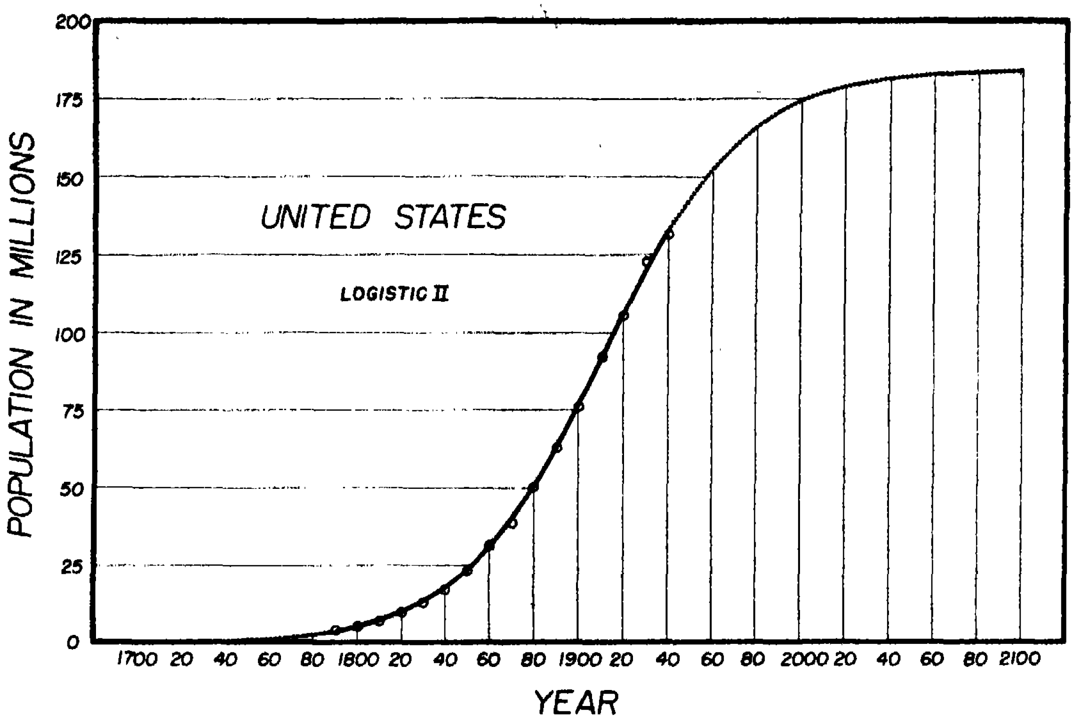

FIG. 2. Logistic curve II (smooth curve) fitted to the census counts (circles) of the population of the United States from 1790 to 1940 inclusive.

not know, and shall not know until the count of 1950 gives some indication as to whether the discrepancy between theory and observation in 1940 is merely a minor fluctuation that will be compensated for in the next ten years, or marks instead the beginning of a different trend of the curve.

But in the meantime, in part as a token of good faith relative to our past promises, we have computed a new logistic curve (Logistic II), using the method of successive least square approximations,[4] to the history of the growth of the population of the United States, including all the recorded data from 1790 to 1940 inclusive. The results are set forth in Table II, and Fig. 2. The equation of this new logistic (Logistic II) is:

$$y = \frac{184.00}{1 + 66.69e^{-0.0322x}} \qquad (2)$$

The constants K and C in (2) are *smaller* than in (1) by amounts that are respectively 6.7 and 0.9 per cent. of their values in (1). The constant r is *larger* in (2) than in (1) by 2.9 per cent. of its value in (1). From Table II the following root mean square deviations are computed

$$\sqrt{\frac{\Sigma(B-A)^2}{16}} = \sqrt{\frac{12.408}{16}} = .8805$$

$$\sqrt{\frac{\Sigma(C-A)^2}{16}} = \sqrt{\frac{29.853}{16}} = 1.3659$$

It is plain that either of the two logistics fits the 16 observed populations very well, considering that each is only a three constant curve. But as to which makes the better forecast of the population to be counted in 1950 we are not prepared to say at this time. We hope to make a statement on the point in 1950.

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THE HEPARINS OF VARIOUS MAMMALIAN SPECIES AND THEIR RELATIVE ANTICOAGULANT POTENCY

ON the basis of studies of impure beef heparin Jorpes[1] postulated that heparin is a mixture of mucoitin polysulfuric acids, the anticoagulant action of which is dependent on the sulfate groups, the potency increasing with increasing sulfur content. The isolation of the crystalline barium salt of heparin by Charles and Scott[2] has made it possible to prepare large amounts of the pure anticoagulant. Working with samples of this crystalline material isolated from different tissues of the ox, Charles and Todd[3] could find no evidence of the heterogeneity claimed by Jorpes. Similar findings have been reported by Jaques and Waters[4] for the crystalline barium salt of heparin isolated from the blood of dogs in anaphylactic shock.

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[4] R. Pearl, "Introduction to Medical Biometry and Statistics." Third Edit. Chapter XVIII *passim*. Philadelphia: W. B. Saunders Company, 1940.

[5] Professor Pearl died on November 17.

[1] Jorpes, *Biochem. Jour.*, 29: 1817, 1935; *ibid.*, 33: 47, 1938.

[2] Charles and Scott, *Biochem. Jour.*, 30: 1927, 1936.

[3] Charles and Todd, *Biochem. Jour.*, 34: 112, 1940.

The latter authors reported that crystalline heparin isolated from dog tissue has a much greater anticoagulant potency than that from beef, suggesting a species difference. More recently, heparin has been isolated as the crystalline barium salt from pig and from sheep lung, and these also have been found to differ in potency. The potencies of samples of crystalline heparin isolated from the four species are listed in Table I. The anticoagulant in each case was purified and crystallized as described by Charles and Scott. The potency was determined by comparison with a standard preparation of pure beef heparin, using a modification of the Howell method. It is evident that heparin isolated from different species varies greatly in potency; *i.e.*, different heparins occur in different species. The barium salts of the various heparins all crystallize in the typical rosettes and sheaves described for beef heparin by Charles and Scott and apparently require almost identical conditions for crystallization. It is rare for a biological substance to show such widely differing activity in different species without a corresponding variation in crystalline structure.

TABLE I

THE ANTICOAGULANT POTENCY AND SULFUR CONTENT OF HEPARINS FROM DIFFERENT SPECIES*

Source	Potency u/mg	S. content %
Dog	240	10.8
Ox	100	10.8(2)
Pig	44	10.4
Sheep	23	11.6

* In each case the potency reported is for the air-dried crystalline barium salt, while the sulfur content is for the same sample after removal of the water of crystallization (about 10 per cent).

The sulfur contents of the various heparins are also shown in Table I. While there are minor variations in these values, there is no correlation between the potency and sulfur content of these heparins. For example, as previously reported by Jaques and Waters, the sulfur content of dog heparin is no greater than that of the heparins from other species, although its potency is 2½ times that of the beef and 10 times that of the sheep heparin. Furthermore, in the 4 mammalian species studied, sheep heparin has the highest sulfur content and lowest potency. Hence, although removal of the sulfur inactivates heparin (Charles and Todd), the very high anticoagulant activities of the crystalline material from dog, beef and pork tissue must be due in part to factors other than the high sulfur content.

Investigations in these laboratories support the conclusions of Charles and Todd that the heparin in any one species is a chemical individual. It is evident, however, *that different heparins are found in different species.*

L. B. JAQUES

DEPARTMENT OF PHYSIOLOGY,
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SCIENTIFIC APPARATUS AND LABORATORY METHODS

ELECTRO-FOLIAR DIAGNOSIS

WHILE investigating the alkalinity of greenhouse soils, caused by the use of hard water, and its relationship to chlorosis in plants, especially the role of iron and manganese as a cause of the chlorosis, the idea occurred that perhaps qualitative or semi-quantitative spot tests for these elements could be obtained by electrolyzing the leaf tissue and catching the removable ions in chemically treated filter papers. Accordingly, a suitable form of the well-known electrolysis apparatus was improvised which includes a common table clamp to hold the plant leaves, filter papers and electrodes, a 45-volt B-battery, a nickel crucible cover for the cathode, and a 1½-inch platinum disk for the anode. The general features of the apparatus are shown in Fig. 1.

The following technique was found suitable for the determinations: A plant leaf was perforated over an area of about four square centimeters by placing it on the convex side of a watch glass and tapping it with the teeth points of a fine comb. The perforated leaf was then laid between two small filter papers, which were saturated previously with a dilute acetic acid solution, and the whole then placed between the electrodes. After clamping the electrodes firmly together between insulators, and with suitable electrical connections, the current was passed through the leaf. Perforating the leaf in the manner described, and saturating the filter papers with an acid or salt solution, lowers the electrical resistance of the whole considerably and thus increases the efficiency of the electrolysis. Two minutes' time for current passage gave good tests for nitrates, phosphorus, iron and manganese in certain cases. Obviously, the proper kind of electrodes, current strength, chemical treatment of the filter papers and other experimental conditions to use will depend on the special tests to be made with the apparatus. In all cases, however, the filter papers must be free from the ions under test.

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[4] Jaques and Waters, *Amer. Jour. Physiol.*, 129: 389, 1940.

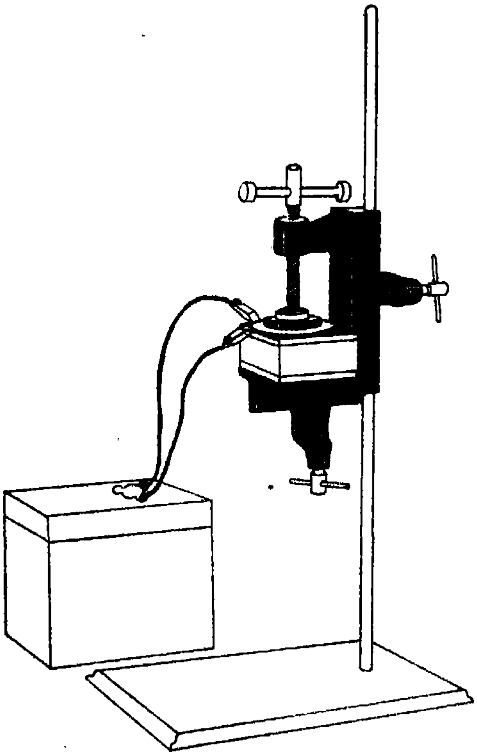

FIG. 1

The method is susceptible to various modifications. An important feature in its operation is the short distance of travel of the ions from the leaf to the papers, which reduces the time period required for a determination. Several papers may be used together when it becomes necessary to separate the testing operations, and one or more leaves may be taken depending on the amounts of the ions required for the tests. Paraffin rings on the papers confine the products of an electrolysis. Micro-cells may be formed by means of thin rubber gaskets. Black papers help to better identify white precipitates or light colored crystals under the microscope. Other modifications of technique may be necessary for special applications of the method.

Many important tests can be made with the method, and it should find a general application. In the field of soil fertility, diagnosis, problems pertaining to either deficient or excess plant nutrients, or to other chemical components of the soil, may be studied by means of rapid determinations of ions in the leaves of plants grown on the soil. Electrolysis of plant leaves should give information about the chemical processes and the physico-chemical states of the ions in the plant not obtainable by means of total analysis, the common method. Another possible use of the method is for the rapid detection of selenium, cyanide, arsenic, aluminum or other toxic substances which may be present in plants that have grown on certain soils.

Data are being collected for a more complete publication dealing with the application of the method to some phase of the general project as stated above.

C. H. SPURWAY

MICHIGAN STATE COLLEGE

A SIMPLE "LIVE" TRAP

AN ordinary spring mouse trap is fastened on top of a cigar box and strings tied at A and E (see Fig. 1). The hook at C is baited and a paper clip D is fastened to the end of the second string to hold open the lid of the box (placed upside down). A strong rubber band, B, is then placed around the box and the trap on top is set in the usual manner. When the prospective animal nibbles the bait at C the spring pulls the prop D and the rubber band quickly closes the box.

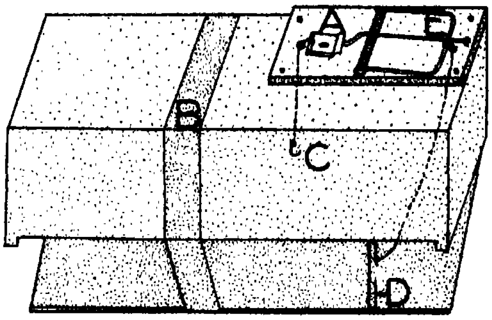

FIG. 1.

This type trap has been found satisfactory for small mammals such as field mice. By employing a larger box and modifying the bait hook it should be useful for larger animals.

If there is danger of surrounding twigs and grass springing the trap prematurely, a guard can be constructed of fine mesh window screen. Total cost per trap is approximately 5 cents plus 10 minutes' time for construction.

M. W. JOHNSON

DUKE UNIVERSITY

BOOKS RECEIVED

GLOYD, HOWARD K. *The Rattlesnakes; Genera Sistrurus and Crotalus.* Pp. vii + 266. Illustrated. Chicago Academy of Sciences.

HOOTON, EARNEST A. *Why Men Behave like Apes and Vice Versa.* Pp. xxv + 234. Illustrated. Princeton University Press. $3.00.

METCALF, MAYNARD M. *Further Studies on the Opalinid Ciliate Infusorians and Their Hosts.* Pp. 465–634. Illustrated. U. S. National Museum.

MITCHELL, LUCY S., ELEANOR BOWMAN and MARY PHELPS. *My Country 'tis of Thee; The Use & Abuse of Natural Resources.* Pp. xv × 335. Illustrated. Macmillan. $3.50.

STANFORD, E. E. *Man and the Living World.* Pp. xxviii + 916. Illustrated. Macmillan. $3.50.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PRELIMINARY ANNOUNCEMENT OF THE PHILADELPHIA MEETING

Edited by Dr. F. R. MOULTON

PERMANENT SECRETARY

The one hundred seventh meeting of the association will be held in Philadelphia from next December 27 to January 2, inclusive. The association was born in Philadelphia on September 20, 1848, and the coming meeting will be its sixth meeting in the city of its birth.

The march of progress of the association and of science is measured roughly by the following data concerning the six Philadelphia meetings, the registration and the number of papers at the approaching meeting being necessarily estimates. The stated membership of the association in 1940 is as of September 30.

Year	Registration	Papers Read	Membership
1848	....	60	461
1884	1,261	305	1,981
1904	890	224	4,041
1914	....	774	8,325
1926	3,181	1,449	14,366
1940	4,000	2,200	21,067

Registration

Registration headquarters will be in Convention Hall, about a block from the major buildings of the University of Pennsylvania where more than half of the general addresses and scientific sessions of the meeting will be held. Branch registration desks will be located in the Bellevue-Stratford and Benjamin Franklin Hotels. A visible directory of all registered persons and their Philadelphia addresses will be available throughout the meeting at the Bellevue-Stratford Hotel.

Each person registering will receive a General Program of the meeting, a book of more than 300 pages which will contain complete information concerning hotel headquarters for all sections and societies, a schedule of dinners and luncheons, announcements of entertainments and social features, a brief description of the science exhibition, complete scientific programs of all sections and societies, an index of all persons appearing on the programs, etc. Each person registering will receive also a badge of admission to all general sessions and to all programs of technical papers. Admission to certain functions, such as the Biologists' Smoker, will be limited to those having registration badges or registration cards.

HOTELS AND HEADQUARTERS

General Headquarters: Bellevue-Stratford Hotel.

Headquarters of the sections of the Association and of the affiliated societies meeting with the Association in Philadelphia are as follows:

Bellevue-Stratford, Broad and Walnut Sts.: All sections of the Association except B, C, D, F, G, H, and O, Association of Symbolic Logic, American Society of Parasitologists, American Science Teachers Association, Society of the Sigma Xi, Phi Beta Kappa, Pi Gamma Mu, Gamma Alpha, Sigma Delta Epsilon, Metric Association, American Philosophical Association, Research Council on Problems of Alcohol, American Association of Scientific Workers. *Rates: with bath—single, $3.50–$6; double, $5–$8.

Adelphia, 13th and Chestnut Sts.: Ecological Society of America, Limnological Society of America, Society of American Foresters. Rates: with bath—single, $3.50–$5; double, $5–$8.

Benjamin Franklin, 9th and Chestnut Sts.: Sections on Physics, Zoological Sciences, Botanical Sciences and Agriculture, American Physical Society, American Association of Physics Teachers, Sigma Pi Sigma, American Society of Zoologists, American Association of Economic Entomologists, Entomological Society of America, Botanical Society of America, American Society of Plant Physiologists, American Society of Naturalists, Genetics Society of America, American Microscopical Society, Sullivant Moss Society, American Fern Society. Rates: with bath—single, $3.50 up; double, $5 up.

Normandie, 36th and Chestnut Sts.: American Society for Horticultural Science, Potato Association of America, American Meteorological Society. *Rates: with bath—single, $3 up; double, $5 up.

Philadelphian, 39th and Chestnut Sts.: American Phytopathological Society, Mycological Society of America. Rates: with bath—single, $2.50–$5; double, $4–$8.

Ritz-Carlton, Broad and Walnut Sts.: Section on Chemistry, American Nature Study Society. *Rates: with bath—single, $3.50–$5; double, $6–$10.

Robert Morris, 17th and Arch Sts.: Section on Astronomy, American Astronomical Society, National Association of Biology Teachers. Rates: with bath—single, $2.50–$4; double, $4–$6.

Stephen Girard, 2027 Chestnut St.: Section on Anthropology, American Anthropological Association. Rates: with bath—single, $2.50–$3.50; double, $4–$6.

OTHER HOTELS IN PHILADELPHIA

Barclay, Rittenhouse Square, E.: Rates: with bath—single, $4.50–$8; double, $7–$10.

Belgravia, 1811 Chestnut St.: Rates: with bath—single, $3–$4; double, $5–$8.

Drake, 1512 Spruce St.: Rates: with bath—single, $3.50–$4; double, $6–$7.

McAlpin, 10th St. at Chestnut: *Rates: with bath—single, $2.25–$2.75; double, $4–$5.

Rittenhouse, 22nd and Chestnut Sts.: *Rates: with bath—single, $2.50 up; double, $3.50 up.

St. James, 13th and Walnut Sts.: Rates: with bath—single, $2.75–$4; double, $4.50–$6.

Spruce, 13th and Spruce Sts.: Rates: with bath—single, $1.75–$2.50; double, $2.50–$3.75.

Sylvania, Juniper and Locust Sts.: Rates: with bath—single, $3–$5; double, $5–$7.

Tracy, 36th St. above Chestnut: *Rates: with bath—single, $2–$2.50; double, $3–3.50.

Walton, Broad and Locust Sts.: *Rates: with bath—single, $2.50–$4; double, $4–$8.

Warburton, 20th and Sansom Sts.: *Rates: with bath—single, $3; double, $5.

Warwick, 17th and Locust Sts.: Rates: with bath—single, $4.50–$5.50; double, $7–$8.

Wellington, 19th and Walnut Sts.: Rates: with bath—single, $4–$5; double, $6–$8.

TRANSPORTATION

Philadelphia is readily accessible by railroads, planes and buses. Holiday rates will probably be in effect on all railroads during the period of the meeting. Information respecting these special reduced rates should be obtained from local agents of the transportation companies.

The regular (not reduced) round-trip railway and airplane fares to Philadelphia from representative cities are as follows:

	Railroad fare	Pullman fare	Airplane fare
Atlanta	$36.70	$12.10	$ 78.80
Boston	21.00	5.30	29.30
Chicago	44.70	11.60	72.26
Cleveland	27.50	6.30	41.76
Minneapolis	63.05	16.90	99.76
New Orleans	58.50	18.90	125.10
St. Louis	52.30	14.20	87.66

By special arrangement, the Yellow Cab Company of Philadelphia will have on sale at the various hotels strips of four tickets for $1.00 which will be honored between any centrally located hotel and the University of Pennsylvania or Convention Hall, the fare for one person being two tickets and for more than one person one ticket each. The Philadelphia Rural Transit Company will provide bus service over a route of easy access from all central city hotels at a round-trip fare of 25 cents on special schedules to meet the varying demands of those attending the scientific sessions that will be held at the University of Pennsylvania. In addition, street cars out Walnut Street go on Woodland Avenue near the principal buildings of the university. The walking time from the Bellevue-Stratford Hotel to Irvine Auditorium, near the center of the university buildings, is about 30 minutes.

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* Hotel has single and double rooms without bath. The Y.M.C.A., 1421 Arch Street, can provide rooms without bath for men only or for married couples. A small number of rooms are available at the Y.W.C.A., Crozer Hall, 2039 Cherry Street, and at the Central Branch, 1800 Arch Street.

OFFICIAL MEETINGS

The Executive Committee of the Council will meet at 4:00 P.M. on Thursday, December 26, in the permanent secretary's rooms in the Bellevue-Stratford Hotel, and thereafter as it shall determine.

The Council of the association will meet at 2:00 P.M. on Friday, December 27, in the Junior Room of the Bellevue-Stratford Hotel, and thereafter as it shall determine.

The Academy Conference will be held on Friday, December 27, in the Junior Room of the Bellevue-Stratford Hotel at 3:30 P.M., or immediately after the adjournment of the council. The conference will be followed by a complimentary dinner to one representative of each affiliated academy and to designated representatives of the association. Since the address of the retiring president will be delivered on the same evening, the dinner will begin at 6 o'clock.

The Secretaries Conference will begin with a dinner in the Bellevue-Stratford Hotel at 6:00 P.M. on Sunday, December 29, and will be followed by the discussion program.

ANNUAL SCIENCE EXHIBITION

The annual science exhibition will be held in Convention Hall from 10:00 A.M. on Friday, December 27, to 1:00 P.M. on Tuesday, December 31. In general, the exhibition will be open from 10 A.M. until 6 P.M., but on Friday it will be open until 8 P.M. so that it may be conveniently visited before the presidential address of Dr. Walter B. Cannon, which will be delivered in the Auditorium of the same building.

GENERAL SESSIONS

All evening general sessions, except the address of Dr. Walter B. Cannon, will be held in Irvine Auditorium, which is located at the northwest corner of Spruce and 34th Streets, on the grounds of the University of Pennsylvania.

On Friday, December 27, at 8:15 P.M., Dr. Walter B. Cannon, George Higginson professor of physiology in Harvard Medical School, will deliver his address as retiring president of the American Association for the Advancement of Science on "The Body Biologic and the Body Politic."

On Sunday, December 29, at 8:15 P.M., Walter Lippmann, author, editor and columnist, will deliver the sixth annual Phi Beta Kappa lecture in Irvine Auditorium.

On Monday, December 30, at 4:30 P.M., Dr. Edmund Ezra Day, president of Cornell University, will deliver the second annual Phi Kappa Phi address in Irvine Auditorium on "The Discipline of Free Men."

On Monday, December 30, at 8:15 P.M., Dr. Anton Julius Carlson, emeritus Frank P. Hixon professor of physiology in the University of Chicago, will deliver the nineteenth annual lecture under the joint auspices of the American Association for the Advancement of Science and the Society of the Sigma Xi. The subject of Dr. Carlson's lecture is "Science versus Life."

ENTERTAINMENT, LUNCHEONS AND DINNERS

The Local Committee will hold a reception for the officers and members of the association and their guests in the Ball Room in Convention Hall, immediately following the address of Dr. Walter B. Cannon on Friday evening, December 27.

The Local Entertainment Committee is planning a tea and music for registrants at the meeting from 3:30 to 6:00 on Sunday afternoon, December 29, in Exhibition Hall.

The American Society of Naturalists, in cooperation with other biological societies and with the association, will hold the Annual Biologists' Smoker at 9:30 P.M. on Monday, December 30. Admission to the smoker will be limited to persons registered for the meeting.

Section on Physics, the American Physical Society and the American Association of Physics Teachers will hold a joint dinner on December 27.

Sigma Pi Sigma will hold a luncheon on Friday, December 27.

Section on Chemistry will hold a dinner on Friday, December 27.

Section on Astronomy and the American Astronomical Society will hold a joint dinner on Tuesday, December 31.

Section on Geology and Geography will hold a smoker at Bryn Mawr College on Saturday, December 28, under the auspices of its Department of Geology.

Section on Zoological Sciences and the American Society of Zoologists will join in their annual dinner for all zoologists on Tuesday, December 31.

The American Association of Economic Entomologists and the Entomological Society of America will hold their annual entomologists' dinner on Saturday, December 28.

The American Society of Parasitologists' luncheon will be on Tuesday, December 31.

Section on Botanical Sciences and affiliated societies will hold the annual dinner for all botanists on Tuesday, December 31.

American Phytopathological Society's annual dinner will be on Saturday, December 28.

American Society of Plant Physiologists will hold its annual dinner on Monday, December 30.

The Ecological Society of America's annual dinner will be held on Saturday, December 28.

The Genetics Society of America will hold its annual luncheon on Tuesday, December 31.

The Section on Anthropology and the American Anthropological Association will join in a dinner on Saturday, December 28.

The Sections on Psychology and Education will hold a joint dinner on Monday, December 30.

The Subsection on Dentistry of the Section on Medical Sciences will hold a luncheon on Saturday, December 28.

Pi Gamma Mu will hold its annual luncheon on Tuesday, December 31.

Sigma Delta Epsilon will hold a luncheon for all women in science on Friday, December 27.

SECTION AND SOCIETY PROGRAMS

In addition to the 15 sections of the association, about 40 affiliated and associated societies will participate in the meeting. The programs of some of the sections and participating societies are not yet available.

The Section on Mathematics and Affiliated Societies (*Dec. 27–28*) will hold sessions on Friday morning and afternoon and a joint session with the Association for Symbolic Logic and the Eastern Division of the American Philosophical Association on Saturday morning.

The Section on Physics and Affiliated Societies (*Dec. 26–30*). The program of the American Physical Society will begin on Thursday morning, December 26. The Section on Physics, the Section on Geology and Geography and the American Physical Society will hold a joint session on Friday morning on "Some Applications of Physics to the Earth Sciences." Papers will be read by L. Don Leet, Chester R. Longwell, William D. Urry and Robert E. Horton. On Friday afternoon the section will hold a joint session with the American Physical Society and the American Association of Physics Teachers, at which John Zeleny, president of the American Physical Society, will deliver an address on "Ions as Gases," and Ernest O. Lawrence, retiring vice president for the Section on Physics, will speak on "Higher Energies." The third paper of the session will be by Robley D. Evans on "Applications of Nuclear Physics." On Friday evening the section and the two affiliated societies will have a joint dinner at which the Duddell Medal of the Physical Society of London will be presented by the British Ambassador, Lord Lothian, to Ernest O. Lawrence.

On Saturday morning the American Association of Physics Teachers will hold a session for contributed papers on "Demonstrations and Laboratory Equipment"; and in the afternoon a session for invited papers on "Medical Physics." On Sunday the society will visit the annual science exhibition in Convention Hall and the laboratories of physics of Bryn Mawr, Haverford and Swarthmore colleges.

On Monday morning the American Association of Physics Teachers will hold a joint session with the American Science Teachers Association for the presentation of the Oersted Medal and for witnessing a demonstration lecture on television. On Monday afternoon the society will hold a session for the presentation of contributed papers on the method and the philosophy of teaching and on related subjects.

The Section on Chemistry (*Dec. 27–30*). The program of the section will consist of two sessions on each of three days—Friday, Saturday and Monday. On Friday the program will be a symposium on "Organometallic Compounds," which will be introduced by Henry Gilman, retiring chairman of the section. Other participants will be Avery A. Morton, Edgar C. Britton, A. V. Grosse, Charles P. Smyth, Robert A. Kehoe and George Calingaert. Following the dinner of the section in the evening, Dr. Gilman will deliver his address as retiring vice president of the association on "Some Biological Applications of Organometallic Compounds."

At the sessions on Saturday a group of invited and carefully selected contributed papers will be presented, the first of which will be on "Sulfathiozole and Sulfapyridine," by George W. Raiziss, of the Abbott Dermatological Research Laboratories.

On Monday, under the leadership of C. A. Browne, of the U. S. Department of Agriculture, the program will be a symposium organized in commemoration of the hundredth anniversary of the publication of Liebig's celebrated book on "Organic Chemistry in its Applications to Agriculture and Physiology," and presented at joint sessions with the Section on Agriculture. The several participants in this symposium will present the influence of Liebig and his pupils on various branches of agricultural science, such as soils, fertilizers, plant physiology, enzymology, crop production and animal nutrition, and their present states.

It is expected that the papers of this symposium will be of such a high order of merit that they will be published by the association as a monograph.

All meetings and functions of the section will be held in the Ritz-Carlton Hotel. Sessions will be arranged so that it will be convenient for the members to visit the science exhibition and to attend some of the general addresses. Chemists who are not members of the association may attend the sessions of the section by paying the registration fee of one dollar.

The Section on Astronomy and the American Astronomical Society (*Dec. 30–31*). The section will hold joint sessions with the American Astronomical Society throughout Monday and Tuesday at the Franklin Institute. At the close of the session on Monday afternoon there will be an official welcome at the University of Pennsylvania and a tea at the Flower Observatory, followed by a visit to the Cook Observatory. On Monday evening there will be a special demonstration at the Fels Planetarium and an inspection of the Astronomical Section of the Franklin Institute.

Tuesday will be devoted to sessions for the presentation of papers. The address of Everett I. Yowell, chairman and vice president for the Section on Astronomy, will be on "Motions of the Stars." On Tuesday evening the section will join with the American Astronomical Society in its annual dinner.

The Section on Geology and Geography (*Dec. 27–30*) will hold eight sessions, starting on Friday morning and ending on Monday afternoon. The program of the first session will be a joint symposium by the Section on Geology and Geography, the Section on Physics and the American Physical Society on "Some Applications of Physics to the Earth Sciences." On Friday afternoon there will be a session on the geology of the Atlantic Coastal Plain, with a series of papers on the Cretaceous-Tertiary problem.

In joint sessions with the Geological Society of America, the section will devote Saturday and Sunday to "Appalachian Geology." A special feature will be a symposium on "Igneous Phenomena in the Appalachians," arranged by the Philadelphia Geological Society. In connection with this symposium Harry H. Hess, retiring president of the society, will deliver an address on "The Appalachian Peridotite Belt."

The retiring chairman of the section, Kirk Bryan, will deliver his vice presidential address at Bryn Mawr College on Saturday evening, on "The Geologic Antiquity of man in North America." At the conclusion of Dr. Bryan's address, there will be a smoker under the auspices of the Department of Geology of Bryn Mawr College.

Monday has been set aside for a joint meeting with the Association of American Geographers. The program will include a few general papers, but will be concerned primarily with the geography of national defense. Special map exhibits are being arranged to illustrate this topic, as well as the historical development of the Philadelphia district. There will also be an exhibit of areal photographs and mosaics, with special reference to the Atlantic Coastal Plain.

The Section on Zoological Sciences (*Dec. 31*) will hold a business meeting on Tuesday noon and a joint dinner with The American Society of Zoologists on Tuesday evening, at which Leon J. Cole, vice president for the section, will deliver his retiring address on "Each after His Kind."

The American Society of Zoologists (*Dec. 30–31, Jan. 1*), on Monday afternoon, will hold a special joint session with The Ecological Society of America on "Population Problems in Protozoa," at which six papers will be presented, the speakers being Lorande L. Woodruff, G. Evelyn Hutchinson, Richard P. Hall, Willis Johnson, W. H. Taliaferro and W. C. Allee.

A second special session will be held on Tuesday morning on "The Endocrine Control of the Mammalian Reproductive Cycle," at which papers will be read by Frederick L. Hisaw, William C. Young and Edwin B. Astwood.

A third special program will be presented at a joint session with The American Society of Naturalists on Wednesday afternoon on "Experimental Control of Development and Differentiation." The large general programs of the society of 300 or more papers will be arranged under its various sections as usual.

American Association of Economic Entomologists and The Entomological Society of America (*Dec. 27–30*). In addition to sessions for the presentation of general papers, the societies, on Friday afternoon, will join in a symposium on "The Breeding of Cultivated Plants Resistant to Insect Attacks." The participants include R. O. Snelling, J. G. Bigger, C. M. Packard, S. F. Bailey and R. H. Painter. On Saturday evening the societies will join in their annual dinner.

Harry S. Smith, president of the American Association of Economic Entomologists, on Friday morning will deliver his presidential address on "The Segregation of Insect Populations into Races and its Significance in Applied Entomology."

R. E. Snodgrass will deliver the annual public address of The Entomological Society of America on Friday evening, his subject being "The Evolution of the Arthropods." On Monday morning the society will hold a joint session with the Ecological Society of America on "Insect Ecology."

The American Society of Parasitologists (*Dec. 30–Jan. 1*) is one of the sponsors of the symposium on "Human Malaria" (Section on Medical Sciences). On Tuesday morning David H. Wenrich, president of the society, will deliver an address on "The Morphology of Some Protozoan Parasites in Relation to Microtechnique." The society will hold a luncheon on Tuesday noon and a demonstration program of 31 papers will be presented on Tuesday afternoon. The program, consisting of 77 papers and demonstrations, is the largest in the history of the society.

The Section on Botanical Sciences and Affiliated Societies (*Dec. 28*). On Saturday afternoon the section will hold a joint session with its affiliated societies, the program of which will consist of the address of the retiring vice-president for the section, Neil E. Stevens, and of invited papers. The title of Dr. Stevens's address is "Botanical Research by Unfashionable Technics." The invited papers are "Comparative Studies on the Structure of the Shoot Apex in Seed Plants," by Adriance S. Foster, "Plants and Exchangeable Calcium of the Soil," by William A. Albrecht, and "Chlorophyll as a Part of the Photosynthetic Mechanism," by O. L. Inman.

The Botanical Society of America (*Dec. 30–Jan. 1*) will hold sessions of its four sections on Monday, Tuesday and Wednesday. On Tuesday morning the Physiological Section will join with the American Phytopathological Society and the American Society of Plant Physiologists for a session on "Physiological Aspects of Plant Diseases." In the afternoon the same section will participate in a joint session with the American Society of Plant Physiologists and the American Society for Horticultural Science to discuss "Selected Aspects for Plant Nutrition."

On Wednesday morning the society will join the Genetics Society of America and the American Society for Horticultural Science in a symposium on "Polyploidy." On Wednesday afternoon it will join the American Society of Naturalists for a symposium on "Experimental Control of Development and Differentiation."

The annual dinner for all botanists will be held on Tuesday evening, at which Carl M. Wiegand, retiring president of the society, will deliver an address.

The American Phytopathological Society (*Dec. 27–31*) will participate in six joint sessions, hold one symposium and two special conferences. In addition, it will hold one demonstration session on Sunday afternoon. The annual dinner of the society will be on Saturday evening.

The society will hold a joint session on Saturday with the Section on Botanical Sciences; on Monday morning, with the American Association of Economic Entomologists; on Tuesday morning, with the Ornamental Section of the American Society for Horticultural Science, and also with the Physiological Section of the Botanical Society of America and the American Society of Plant Physiologists; and on Tuesday afternoon, with the Mycological Society of America, and also with the Potato Association of America. On Monday evening the society will hold a symposium on "Better Undergraduate Training for Future Plant Pathologists."

The American Society of Plant Physiologists (*Dec. 28–31*), in addition to a joint session with the Section on Botanical Sciences on Saturday, will hold two symposia, one on Monday on "The Structure of Protoplasm" and one on Tuesday afternoon in collaboration with the American Society for Horticultural Sciences and the Botanical Society of America on "Plant Nutrition." The participants in the symposium on the "Structure of Protoplasm" are Laurence S. Moyer, Charles Hock, George Scarth, O. L. Sponsler, Warren H. Lewis, Douglas A. Marsland, Noburo Kamiya, C. L. Huskins and William Seifriz.

The society will hold joint sessions with the American Phytopathological Society on Tuesday morning and with the Society of Naturalists on Wednesday afternoon. At the annual dinner of the society on Monday evening, J. W. Shive will deliver a combined Stephen Hales-presidential address on "Significant Roles of 'Trace' Elements in the Nutrition of Plants," and at the same session, the recipients of the Charles Reid Barnes and the Stephen Hales awards will be announced. A special session on the teaching of plant physiology will be held on Tuesday evening. General sessions will be held on Monday afternoon, Tuesday morning and Wednesday morning and afternoon.

The Mycological Society of America (*Dec. 28–31*) will hold a joint session with the Section on Botanical Sciences on Saturday, and on Monday afternoon a joint session with the American Phytopathological Society. General papers will be presented at sessions on Saturday, Monday and Tuesday mornings. The principal feature of the program will be the presidential address of D. L. Linder on "The Mycologist and His Relation to Others."

The American Society of Naturalists (*Dec. 30, Jan. 1*) will hold a symposium, arranged by Karl Sax, on Wednesday on "Experimental Control of Development and Differentiation," the speakers being G. W. Beadle and E. L. Tatum, A. F. Blakeslee, B. H. Willier and K. V. Thimann. The Biologists' Smoker, admission to which will be limited to persons registered at the meeting, will be held on Monday evening and the Naturalists' Dinner will be held on Wednesday evening, at which J. H. Bodine will deliver his presidential address on "The Cell—Some Aspects of Its Functional Ontogeny."

The Ecological Society of America (*Dec. 27–30*) on Friday afternoon will join the Section on Social and Economic Sciences in a symposium on "Human Ecology," the speakers at which will be F. H. Pike, J. Russell Smith, Bruce L. Melvin and E. C. Lindeman. On Saturday morning the society will hold a joint session with the Society of American Foresters, on Saturday afternoon a joint session with the Limnological Society of America and on Monday morning a joint session with the Entomological Society of America. An informal banquet will be held on Saturday evening. On Monday afternoon the society will join with the American Society of Zoologists in a symposium on "Population Problems in Protozoa." The annual luncheon of the society will be held on Tuesday noon.

The Genetics Society of America (*Dec. 30–Jan. 1*) will hold two demonstration sessions, one session for invited papers and one for short papers, and will join with the American Society for Horticultural Sciences and the Botanical Society of America in a symposium on "Polyploidy," at which the speakers will be R. E. Clausen, S. L. Emsweller, C. L. Huskins and L. F. Randolph. On Wednesday afternoon the society will join with the American Society of Naturalists in a symposium on "Experimental Control of Development and Differentiation." The annual luncheon of the society will be held on Tuesday noon.

The Limnological Society of America (*Dec. 28–30*) will hold three sessions for the presentation of general papers, and on Saturday afternoon it will hold a joint session with the Ecological Society of America.

The Section on Anthropology (*Dec. 27–30*) will meet jointly with the American Anthropological Association, the American Folklore Society and the Society for American Archeology. Papers are planned on disciplinary studies with special references to integration with cultural and biological disciplines. On the cultural side attention will be focused upon relations with sociology and psychology; on the biological side, upon the relationship of physical anthropology with basic principles of biology, with anatomy, and with medical and dental sciences generally. At the annual dinner on Saturday evening, the retiring president of the American Anthropological Association, J. M. Cooper, and the retiring vice president for the section, N. M. Judd, will both deliver addresses. The section will hold a dinner on Saturday evening, and on Sunday evening it will sponsor an illustrated lecture by Douglas Oliver on "Social Climbing in a Melanesian Plutocracy."

The Section on Psychology (*Dec. 28–30*) will hold a session in two sections on Saturday morning, one session on Saturday afternoon, a session in two sections on both Monday morning and afternoon and a joint banquet with the Section on Education on Monday evening. The session on Saturday afternoon will be devoted to a symposium on "Psychology and the National Emergency," and one of the sections on Monday afternoon will meet in a joint program with the Section on Education.

The Section on Social and Economic Sciences (*Dec. 27*) will join on Friday with the Ecological Society of America in a symposium on "Human Ecology," the participants in which will be F. H. Pike, J. Russell Smith, Bruce L. Melvin and E. C. Lindeman.

The Eastern Division of the American Philosophical Association (*Dec. 26–28*) will hold its meeting from Thursday evening to Saturday afternoon, the Saturday morning program being a joint session with the Section on Mathematics and the Association for Symbolic Logic. The Saturday afternoon program will be a joint session of the American Philosophical Association (including its Eastern Division) and the Section on Social and Economic Sciences of the American Association for the Advancement of Science. Principal papers on this program will be "Science and Value," by Wilbur M. Urban, "Fact and Value in Social Science," by Frank H. Knight and "The Science of Value and the Value of Science," by Ralph Barton Perry. The formal papers will be followed by discussions participated in by Harlow Shapley, Gregory Bateson, Morris R. Cohen and O. H. Taylor.

A plenary session of the society will be devoted to a symposium on "The Nature of Man," participated in by Brand Blanshard, C. I. Lewis and W. H. Sheldon. The subject for consideration at another session will be "The Problem of Religious Knowledge," at which J. S. Bixler, R. L. Calhoun and H. L. Friess will present papers. The president of the Eastern Division of the society, Charles W. Hendel, will deliver his presidential address on a date to appear in the General Program.

The American Association of Scientific Workers (*Dec. 27–28*) will present a symposium on "The Scientist and American Democracy" on Friday afternoon and Saturday morning. The session on Friday afternoon will be introduced by A. J. Carlson in "The Scientist's Concept of a Democratic Society," which will be followed by a discussion of various aspects of "The Scientist and Technology," by A. C. Lane, Charles E. Kellogg and W. Rautenstrauch. At the session on Saturday morning Kirtley F. Mather will read a paper on "The Responsibilities of the Scientist as a Citizen of a Democratic Society," which will be followed by a discussion of various aspects of "The Scientist and Social Problems," by Thomas F. McSweney and Donald E. Montgomery. The session will close with a discussion of "The Preservation of Science," K. A. C. Elliott presenting a paper on "Science in the Belligerent Countries" and L. E. Carmichael a paper on "Science and American Democracy."

Pi Gamma Mu (*Dec. 31*) will hold its usual social science luncheon on Tuesday noon.

The Section on Historical and Philological Sciences is planning to present a symposium on "Scientific Basis for Ethics."

The Section on Engineering (*Dec. 31*) will hold a session on Tuesday morning which will be opened with remarks by Robert L. Sackett, followed by a paper on "Technical Progress in Aviation" by Jerome C. Hunsaker. The remainder of the session will be devoted to discussions of the relations between the Americas, including a paper by Cloyd Heck Marvin on "Cultural Relationships between the Americas" and a paper by Raymond Clapper on "The Press and Inter-American Relations."

At 12:30 the section will have a luncheon at the Engineers Club of Philadelphia at which the speakers will be William Culbertson, former U. S. Ambassador to Chile, and Dr. Carlos Davila, former president of the Republic of Chile.

At the afternoon session Fred Lavis will read a paper on "Engineering Developments in South America"; C. L. Warwick, a paper on "Inter-American Relations in the Field of Engineering Materials"; and P. G. Agnew, a paper on "Exchange of Standards between the Americas."

The Section on Medical Sciences (*Dec. 30–Jan. 1*) will present a symposium on "Malaria" sponsored jointly by the American Society of Tropical Medicine, the American Society of Parasitologists and the National Malaria Committee. The symposium will deal exclusively with human malarias and will be limited in scope to North America, Central America and the West Indies. A total of 39 papers by experts in their separate fields will be presented at six sessions on the mornings and afternoons of Monday, Tuesday and Wednesday. Each author will be limited to 15 minutes for the presentation of his paper, leaving ample time for free discussion. The contributions have been grouped under the headings: "Introduction," "Parasitology," "Anopheline Vectors," "Epidemiology," "The Human Infections: Symptomology," "Pathology," "Therapy" and "Control and Eradication." Abstracts will be prepared and circularized in advance of the meeting, and it is anticipated that the papers will merit publication as a volume in the monograph series of the association.

The Subsection on Dentistry (*Dec. 28*) will present a symposium on "Periodontal Disease." Among those participating will be Balint Orban, E. H. Hutton, J. O. McCall and I. Hirschfeld.

The Subsection on Pharmacy (*Dec. 28*) will hold sessions on Saturday morning and afternoon.

The Research Council on Problems of Alcohol (*Dec. 27–29*) will hold six sessions for the presentation of formal papers in addition to a final session on Sunday evening, at which Thomas Parran, surgeon-general of the U. S. Public Health Service, will deliver an introductory address to be followed by an address by Abraham Myerson, of Harvard Medical School, on "Alcohol—Some Social Considerations."

At the first session, on Friday morning, Wilfred Overholser will deliver an introductory address, which will be followed by eight papers on "Physiological and Chemical Considerations." The participants in this session will be A. C. Ivy, F. A. Hitchcock, H. D. Palmer, H. Newman, Frederick Gibbs and Hallowell Davis, Curt P. Richter, A. Grollman and Thorne Carpenter. At the Friday afternoon session on "Alcoholism—Clinical Aspects," papers will be presented by Philip Piker, H. H. Merritt, W. W. Jetter, Arthur W. Wright, Norman Jolliffe, Timothy Leary and A. J. Carlson.

The general subject for the session on Saturday morning is "Alcoholism—Neuropsychiatric Features." Papers at this session will be read by Foster Kennedy, Leo Alexander, Ross A. McFarland, David Wechsler, Nolan D. C. Lewis, Paul Schilder and E. M. Jellinek. At the Saturday afternoon session the general subject is "Alcoholism—Treatment and Prevention." The participants in this session will be Wilfred Bloomberg, Robert V. Seliger, Karl M. Bowman, Charles E. Parsons, Harry M. Tiebout and Bernard Glueck.

The general subject of the papers to be presented on Sunday morning is "Alcoholism—Social and Legal Problems." At this session papers will be presented by Lawrence Kolb, Edwin R. Keedy, Jerome Hall, Morris Ploscowe, Austin H. MacCormick and an author to be announced. Discussion of the same general subject will be continued in the Sunday afternoon session in papers by Horatio M. Pollock, Donald S. Berry, George S. Stevenson and two others to be announced.

The Section on Agriculture (*Dec. 30*) will join with the Section on Chemistry on Monday in the symposium on "Organic Chemistry in its Applications to Agriculture and Physiology."

The Society of American Foresters (*Dec. 28*) will meet on Saturday morning with the Ecological Society of America.

The American Society for Horticultural Science (*Dec. 30–Jan. 1*) on Monday morning will present its program in four sections—nutrition of fruit trees, nutrition of vegetable crops, ornamental plants and blueberries. On Monday afternoon the program will be a joint session of the Vegetable Crops Section of the society with the Potato Association of America, a general session on physiology of fruit trees, a session on quality and production of vegetable crops and a session on floriculture and ornamental horticulture. The Tuesday morning program will include a joint session of the Ornamental Horticultural Section and the American Phytopathological Society, a general session on fruit trees, a session on breeding vegetable crops, a session on breeding and production of small fruits and a session on storage and processing of horticultural products. On Tuesday afternoon there will be a joint session with the Physiological Section of the Botanical Society of America and with the American Society of Plant Physiologists on "Ion Availability." Tuesday evening will be devoted to round table discussions on nomenclature and varieties, educational methods, experimental design and blueberries.

On Wednesday morning there will be a joint session on "Polyploidy" with the Genetics Society of America and the Botanical Society of America, and sessions on rootstocks and propagation, nutrition of vegetable crops and nutrition of ornamental plants. Wednesday afternoon will be given over to the business session of the society, at which matters of organization and publication policy and changes in the constitution and by-laws are scheduled for thorough discussion.

The Section on Education (*Dec. 30–31*) will hold a symposium on Monday morning on "Conservation Education." On Monday afternoon it will hold a joint session with the Section on Psychology, at which M. R. Trabue will deliver his address as retiring vice president on "Educational Research and the Defense of Democracy." At the same session E. L. Thorndike will present a paper on "Notes on the Psychology of Migration." On Monday evening the section will join in a dinner with the Section on Psychology.

On Tuesday morning the program will be divided into two sections. The program of one section will consist of papers by Donald D. Durrell, G. M. Ruch, P. J. Rulon, Marion Richardson and D. D. Lorge. The papers in the second section will be by Harry J. Baker, Arthur T. Jersild, Milton B. Jensen, Edward G. Olsen, W. C. Eells, and Marjorie T. Bingham and Edward T. Boardman. The Tuesday afternoon session will consist of papers by M. W. Keller, D. R. Shreve and H. H. Remmers (two papers), S. L. Eby, Paul A. Witty, Harold F. Clark, Harold C. Bingham and Alice L. Brown.

The Society of the Sigma Xi (*Dec. 30*) will hold its annual convention on Monday at 4 P.M. On Monday evening the nineteenth annual lecture under the joint auspices of the association and the society will be delivered by Anton J. Carlson on "Science versus Life."

The American Nature Study Society (*Dec. 26–28*) will begin its meeting on Thursday evening with a program, arranged by Charles E. Mohr, on "Acquainting Philadelphians with Natural Study through Field Trips and Amateur Research Projects." The program on Saturday, arranged by E. Laurence Palmer, will be on "Nature Education's Contribution in an International Emergency." At a Saturday morning breakfast George W. Jeffers will be the guest speaker.

The American Science Teachers Association (*Dec. 30*) will hold two sessions and a luncheon on Monday. At the morning joint session with the American Association of Physics Teachers, Albert E. Marshall will present a paper on "New Types of Glass and New Techniques," Richard M. Sutton, president of the American Association of Physics Teachers, will present the Oersted Medal to an outstanding teacher of physics, and T. F. Joyce will present a discussion and demonstration of television. At the luncheon Albert F. Blakeslee will deliver an address on "Taste and Smell." The program for the afternoon session is a symposium on "The Place of Science in General Education," the speakers on which include Watson Davis, Oscar Riddle and K. Lark-Horowitz.

Gamma Alpha Graduate Scientific Fraternity (*Dec. 28*) will hold a luncheon on Saturday noon.

Sigma Delta Epsilon Graduate Women's Scientific Fraternity (*Dec. 27–Jan. 1*) will hold a luncheon for all women in science on Friday noon.

The National Association of Science Writers (*Dec. 29*) on Sunday morning will present a symposium on "Science Reporting in the World Crisis." After the presidential address by G. B. Lal, retiring president of the organization, there will be a series of brief addresses by such scientists as Albert F. Blakeslee, Edwin Grant Conklin and Walter B. Cannon. Then Waldemar Kaempffert, of the *New York Times*, David Dietz, of the Scripps-Howard Papers, Howard Blakeslee, of the Associated Press, John J. O'Neill, of the *New York Herald-Tribune*, Jane Stafford and Watson Davis, of Science Service, Thomas R. Henry, of the *Washington Star*, and probably other science writers for the daily press will participate in short discussions.

OBITUARY

HARRY BURR FERRIS

Harry Burr Ferris, son of Samuel Holmes and Mary Clark Ferris, was born in Greenwich, Connecticut, on May 21, 1865. His death occurred on October 12, 1940, after a brief illness. Educated at the Stamford, Connecticut, High School and Yale University, he received the degree of B.A. in 1887 and his M.D. in 1890.

For more than forty years, as E. K. Hunt professor of anatomy, Dr. Ferris served the Yale School of Medicine, the university and his community with devotion and unceasing effort. Beloved by every one who knew him, his generous sympathy, rare understanding and calm judgment will be missed by all. An extraordinary teacher, he gave of himself without stint in furthering the interests of students and in aiding them to lay a firm foundation for the practice of medicine.

He began his teaching of anatomy immediately after a year of interneship in the New Haven Hospital. During this first year, he engaged in the practice of medicine, but this he soon gave up to devote his entire time to the work in the school. At this period the fortunes of the school were at low ebb, and for the next fifteen years Dr. Ferris, almost single-handed, taught all the courses in anatomy to the first-year students. He received sporadic help from time to time from practicing physicians, but for long periods he was in the classroom for more than forty hours a week. In spite of this heavy drain on his energy, he was uniformly patient with the adolescent mind, and even sheer stupidity did not ruffle his calm judgment.

His knowledge of anatomy was prodigious and his memory frightening. His lectures are unforgettable. They were delivered quietly, without notes, and were lucid and logical expositions of the facts of anatomy, enriched with frequent references to the problems of clinical medicine. Even the unusually heavy burden of teaching did not quench his interest in fundamental medical science. Precluded from being a prolific producer of scientific articles by his unselfish devotion to the needs of the student, he nevertheless kept alive an eager concern for science. From this interest came occasional papers laboriously and carefully written in such time as he could steal from his teaching duties.

With the advent of Dr. Blumer as dean of the school in 1910, Dr. Ferris's path was made easier with the addition of first one and then two assistants until, at the time of his retirement in 1933, the department had been built up to a personnel of five full-time members. Dr. Ferris was ever unmindful of self and labored constantly to further the interests of his staff. Even though added members made his labors less continuous, yet he always did far more than his share in order that his staff might have time for productive research. He was completely uninterested in fame and fortune, striving always for what he deemed the best interests of the school and its personnel.

Dr. Ferris was one of a group of six great teachers of anatomy in the past generation. With Mall of Johns Hopkins, Piersol of Pennsylvania, Huntington of Columbia, Huber of Michigan, Jackson of Minnesota, stands Ferris of Yale. Profound in their knowledge of anatomy, expert in its exposition and jealous of its traditions, they stood for a concept of anatomy which has practically disappeared from the land. They believed in anatomy as a science, that one could never know too much of it; but they never forgot that anatomy was part of medical science and that the students who went through their hands would eventually be physicians. They believed that anatomy could be reified through examples drawn from the clinic, quite as successfully as from animals used in the experimental laboratory.

With the passing of Dr. Ferris, a chapter is closed; a chapter which can be opened only in memory. To all who knew him, Dr. Ferris will always be remembered as a great anatomist, a great teacher and, greatest of all, a great friend.

H. S. Burr

Yale University School of
Medicine

ELVIN L. VERNON

After an illness of three months, Dr. Elvin L. Vernon died on September 27, 1940. He is survived by his wife and son.

He was born in Prescott, Washington, in 1908. After attending the University of Alaska for two years, he returned to this country and completed his undergraduate training at Oregon State College, where he received a bachelor of science degree in chemical engineering in 1928. He went to the University of Washington for some graduate work, then to the University of Wisconsin, where he was in 1932 granted a doctor of philosophy degree in physical chemistry and mathematical physics.

During his years at Wisconsin, he made a theoretical study of solutions of strong electrolytes with H. Falkenhagen, and three papers, on the viscosity and on the dielectric constant of such solutions, were published. For his doctorate thesis, he carried on experimental work with Farrington Daniels on the kinetics of the dissociation of ethyl bromide. The results of this work were later published in the *Journal of the American Chemical Society*.

He was awarded a post-doctorate fellowship to continue his research; after completing this, he turned to the field of teaching. Following his earlier experience as assistant in the chemistry laboratories at Wisconsin, he accepted a position with the People's Junior College in Chicago, where he instructed in chemistry and physics.

Later, at Harvard University, he again took up research, with a study in mathematical physics with A. S. Coolidge and H. S. James. A paper "On the Determination of Molecular Potential Curves from Spectroscopic Data" was published, and Dr. Vernon was before his death extending the methods and computations, there applied to the hydrogen molecule, to other elements.

From Harvard he went to the faculty of the City College of New York, and had completed a year there, teaching chemistry, when he was suddenly taken ill.

His ability had been recognized by several honorary societies; he was a member of Sigma Xi, Phi Lambda Upsilon and Kappa Kappa Psi. He had also joined several professional societies: the American Chemical Society, the American Mathematical Society and the Society of Rheology.

Both in his professional work and in other fields his keen, clear mind made his opinions and studies authoritative. As a teacher, his logical and lucid explanations were excellent; several students have commented to the author on the clarity of Dr. Vernon's presentations. His friends knew him to have complete sincerity and integrity. His keen, dry sense of humor and precision of expression made it an intellectual treat to hear him speak. His thorough training in the three fields of mathematics, physics and chemistry, gave him unusual ability in his varied research work, and enabled him to teach with a breadth of vision.

WORDEN WARING

TULANE UNIVERSITY

RECENT DEATHS

DR. HENRY HURD RUSBY, professor of botany, physiology and materia medica and dean emeritus of the New York College of Pharmacy, Columbia University, died on November 18 at the age of eighty-five years.

FRED E. GLADWIN, chief in research in pomology of the New York State Agricultural Experiment Station, died on November 16. Mr. Gladwin had been in charge of the station's Vineyard Laboratory at Fredonia, N. Y., since 1909.

DR. JOHN P. TURNER, assistant professor of zoology at the University of Minnesota, died on November 11 at the age of thirty-eight years.

PROFESSOR J. FRANKLIN COLLINS, taxonomist and forest pathologist, died on November 15, after a long illness. A correspondent writes: "He would have been seventy-seven years old in the last of December. Professor Collins was assistant professor of botany, curator of the Olney Herbarium and chairman of the department at Brown University until 1911, and from then until his retirement in 1934, he was successively forest pathologist, pathologist and senior pathologist, in charge of the Office of Forest Pathology, of the Bureau of Plant Industry, located at Brown University, which dealt with the diseases of trees and ornamental shrubs. During the latter period he was also lecturer and curator of the herbarium at Brown University."

SIR FREDERIC STUPART, formerly director of the Meteorological Service of Canada, died on September 27 in his eighty-fourth year. A correspondent writes: "Sir Frederic entered the Meteorological Service of Canada just after it was organized, in December, 1872, became director in December, 1894, and retired in July, 1929. He was knighted in June, 1916. He was a past president of the American Meteorological Society, an honorary life member of the Royal Meteorological Society of England and a fellow of the Royal Society of Canada. He issued the first weather forecasts from the Canadian Service and had much to do with the development of the Meteorological Service since its inception until the time of his retirement. He was prominent at the international meteorological meetings held during his term as director, and published many articles, especially on the climatology of Canada."

ERNEST WILLIAM MACBRIDE, since 1919 until his retirement in 1934 professor emeritus of zoology of the Imperial College of Science, South Kensington, of the University of London, Strathcona professor of zoology at McGill University from 1897 to 1909, died on November 19. He was seventy-three years old.

SCIENTIFIC EVENTS

THE PLANT, SOIL AND NUTRITION LABORATORY BUILDING OF THE FEDERAL GOVERNMENT AT CORNELL UNIVERSITY

THE United States Plant, Soil and Nutrition Laboratory Building which the Federal Government has erected at Ithaca, according to the *Cornell Alumni News*, opened this autumn under the direction of Dr. Leonard A. Maynard, professor of animal nutrition at the university. Some of its staff hold joint appointments with the U. S. Department of Agriculture and the university; others are members of the university whose research is being coordinated with that of the laboratory.

Dean Carl E. Ladd, of the College of Agriculture, explains that the laboratory "will attempt to coordinate all present knowledge of vitamins, the effect of minor mineral elements on plants, and the results of lack of essential elements on the health and growth of animals and people. It will, in general, enlarge present knowledge of plant and animal nutrition and project present knowledge into new fields."

Coincidently with its opening, the university announced appointment of Dr. Karl C. Hamner as assistant professor of plant physiology in the department of botany, to be in charge of plant investigations in the laboratory, and of Dr. Gordon H. Ellis as biochemist in the laboratory and assistant professor of biochemistry and nutrition.

Professor Hamner has been for three years a member of the department of botany at the University of Chicago, part of his research dealing with relations of hormones and vitamins to plant growth.

Professor Ellis has been an instructor in animal nutrition, working with Professor Maynard and Professor Clive M. McCay on the relation of diet to age changes, with special reference to the chemistry and physiology of lactation.

Two of three projected wings of the new laboratory building, costing $100,000 each, are now completed. The building was designed by the University Department of Buildings and Grounds with Carl C. Tallman as consulting architect, and was constructed by the Federal Government on a site leased from the university.

FELLOWSHIPS OF THE E. I. DU PONT DE NEMOURS AND COMPANY

E. I. DU PONT DE NEMOURS AND COMPANY has awarded six postdoctorate fellowships for research in organic chemistry and twenty postgraduate fellowships for research in the field of chemistry for the academic year 1941–42. Twenty institutions will benefit. The postdoctorate fellowships are for $2,000 each, and the postgraduate fellowships are for $750 each.

The postdoctorate fellowships will be placed under the direction of R. T. Arnold, instructor, University of Minnesota; Paul Bartlett, assistant professor, Harvard University; Ralph Connor, assistant professor, University of Pennsylvania; R. C. Elderfield, assistant professor, Columbia University; C. B. Purves, assistant professor, Massachusetts Institute of Technology, and H. R. Snyder, instructor, University of Illinois. These men will succeed an equal number of faculty members who have held the grant in the past few years. This is in accord with the policy of rotating the grants so that especially meritorious younger instructors and professors may participate in the plan.

Appointments to the postgraduate fellowships will be made later in the academic year by the heads of the chemistry departments of the respective universities. The twenty institutions to which awards have been granted are:

> The University of California, University of Chicago, Columbia University, Cornell University, Harvard University, University of Illinois, the Johns Hopkins University, Massachusetts Institute of Technology, University of Michigan, University of Minnesota, Northwestern University, Ohio State University, Pennsylvania State College, University of Pennsylvania, Princeton University, Purdue University, Stanford University, University of Virginia, University of Wisconsin and Yale University.

Fellowships for advanced work in chemistry were established by the du Pont Company in 1918, when there was a dearth of men adequately trained for chemical research. Through the fellowship plan, the company sought to prepare promising young men for a career in this phase of science. These grants, which with one interruption have been maintained since 1918, differ from the average industrial fellowship in that the selection of the beneficiary and the subject of research are left to the discretion of the university. There is no actual or implied obligation as to future employment of the fellowship holder. The success of this plan is evinced by the fact that its beneficiaries have been widely employed.

Through the postdoctorate phase of the plan, the company provides funds with which gifted younger instructors and professors may carry on broad and difficult researches by employing highly qualified assistants. This assistance is intended not only to increase contributions to science, but also to perfect the technique of these men in teaching chemical research, thus enhancing their interest in remaining in the academic field. The company is mindful of its debt to university chemical faculties and desires its postdoctorate program to open larger avenues of service to promising younger teachers.

THE PAN AMERICAN CONGRESS OF OPHTHALMOLOGY

THE Pan American Congress of Ophthalmology was organized on a permanent basis at the meeting of the first congress, which was held in Cleveland, on October 11 and 12, under the auspices of the American Academy of Ophthalmology and Otolaryngology.

Dr. Harry S. Gradle, Chicago, was elected president of the congress. Drs. Conrad Berens, New York, and Moacyr E. Alvaro, São Paulo, Brazil, who served with Dr. Gradle as members of the committee that organized the initial meeting, were elected executive secretaries.

The following vice-presidents were elected: Drs. S. Hanford McKee, Montreal; Frank E. Brawley, Chicago; Edward Jackson, Denver; Tomas R. Yanes, Havana; A. Vasquez-Barriere, Montevideo, Uruguay; Jose Pereira Gomes, São Paulo, and Enrique Demaria, Buenos Aires.

There will also be a council, which is to be formed by one representative from each of the twenty-one American republics. The representative from each country is to be elected by the national ophthalmological society or societies, if such exist; if there is no such society, the government of the country will be asked to appoint a member of the council.

Montevideo was tentatively selected as the place of the next meeting, to be held in 1943.

Eighteen delegates representing governments, universities, hospitals and medical societies in Brazil, Chile, Costa Rica, Cuba, Colombia, Guatemala, Panama and Puerto Rico were present in Cleveland. An extensive program of scientific papers was presented, about equally divided between English, on the one hand, and Spanish and Portuguese on the other. English papers were discussed by Latin American speakers; those in Spanish or Portuguese by the English-speaking physicians.

The language difficulty was overcome successfully by the use of slides. Extensive summaries of the papers were projected on the slides in Spanish or Portuguese for the English ones, or in English for those given in the other languages.

Earlier in the week the Latin American delegates were guests of the academy at its scientific sessions and at the annual banquet, where each was formally introduced. At the Pan American banquet held on October 11, the guests from Latin America expressed appreciation and enjoyment of the meeting. It was the general impression that the congress had brought about better understanding among the ophthalmologists of the Western Hemisphere. The Latin Americans were impressed by the meetings of ophthalmologists in this country and those of the United States were in turn impressed by the scientific ability and skill of the Latin Americans.

At the conclusion of the meeting the Latin Americans left to attend special clinics that were being held in their honor at some of the large ophthalmological centers of the East and Middle West.

THE NEW YORK MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

THE annual meeting of the American Society of Mechanical Engineers will open at the Hotel Astor, New York, on December 2, instead of at the Engineering Societies Building, the headquarters of the society, where previous meetings have been held. The sessions continue to December 6.

Registration, technical sessions and many social events, including luncheons and dinners, will be at the Hotel Astor, except as specifically noted in the official program.

There are 105 papers announced on the technical program to be read at forty-four sessions. Among the subjects to be treated are: Machine Line Production of Aircraft Materials, Elasticity and Vibration, Fuels, Machine Shop Practice, Work Standardization, Boiler Feedwater Studies, Applied Mechanics, Metals Engineering, Industrial Instruments, Mathematical Statistics, Dust Collection, Power, Petroleum, Handling, Operations in Industrial Plants, Lubrication, Mechanical Springs, Rolling and Plasticity, Port and Terminal Handling, Industrial Marketing, Textile, Ammunition, Management, Safety, Fluid Meters, Training to Meet the National Emergency, Heat Transfer, Hydraulics, Rubber and Plastics, Dynamics of Vehicles, Railroad, Temperature and the Properties of Metals. There will be a symposium on Power in Ships on Thursday evening.

A memorial tablet to Dr. Calvin Winsor Rice, who was secretary of the society from 1906 until his death in 1934, will be unveiled on Monday at noon.

In conformity with usual practice, Wednesday evening will be set aside for the annual banquet at the Hotel Astor, at which Warren H. McBryde, president of the society, will make the principal address and other speakers of national reputation will be heard. Honorary memberships, medals and awards and fifty-year badges will be presented at the annual dinner. A number of other dinners and luncheons will be given during the course of the meeting.

There will be shown at the Astor the annual photographic exhibit of members of the society and other participants. In addition to photographs, there will be a display of photostats of automobiles of the eighteen-thirties, from the collection of Sidney Withington, electrical engineer of New Haven. A wide variety of illustrations, including many cartoons, relating to early self-propelled road vehicles of a century ago will be exhibited.

As usual inspection trips will be made to local plants of interest to mechanical engineers, including a visit to the largest passenger vessel built in a shipyard in the United States, the *S.S. America*. The new airport at North Beach and La Guardia Field will also be visited, as will the new Sixth Avenue Subway, the East-River-Midtown tunnel and the 35-mile belt parkway. Trips to industrial and power plants covering a wide range of special interests are also being provided.

SCIENTIFIC NOTES AND NEWS

THE Hughes Medal of the Royal Society, London, has been awarded to Dr. Arthur H. Compton, Charles H. Swift distinguished service professor of physics at the University of Chicago.

THE George White Medal of the Massachusetts Horticultural Society has been awarded to Sir Arthur William Hill, since 1922 director of the Royal Botanical Gardens at Kew, England. The Jackson Dawson Memorial Medal has been awarded to G. G. Nearing, of Ridgewood, N. J., for his work with rhododendrons. Gold medals have been awarded to A. T. De La Mare, New York publisher of *The Florists' Exchange*, and Arthur Herrington, manager of the New York Flower Show.

DR. CARL P. HUBER, associate professor of obstetrics at the School of Medicine at Indianapolis of Indiana University, has received the 1940 award of the Central Association of Obstetricians and Gynecologists for the best clinical essay. The title of the paper, which was prepared with the assistance of Dr. Jack C. Shrader, 1940 graduate of the Medical School and now an intern in the Indianapolis City Hospital, was "Blood Prothrombin Levels in the Newborn." Dr. Shrader received the Ravdin Gold Medal awarded to the student with the highest rank at the June commencement.

The council of the British Institution of Mechanical Engineers has awarded the James Watt International Medal to Professor Aurel Stodola, of Zurich, on the recommendation of the Engineering Institute of Canada, the Czechoslovak Society of Engineers and the Swiss Society of Engineers and Architects. The medal, which was founded in 1936 to commemorate the bicentenary of the birth of James Watt on January 19, 1736, is awarded every two years to an engineer of any nationality who is deemed "worthy of the highest award that the institution can bestow and that a mechanical engineer can receive." In making the award the institution has secured the cooperation of engineering institutions and societies in all parts of the world.

The Crompton Medal of the British Institution of Automobile Engineers has been awarded to Dr. J. S. Clarke, of Birmingham Corporation Gas Department, for a paper entitled "The Use of Gas as a Fuel for Motor-vehicles."

A dinner in honor of Dr. Harry Stoll Mustard, the new director of the De Lamar Institute of Public Health of the College of Physicians and Surgeons of Columbia University, was given on November 19 by the Alumni Association at the Hotel George Washington. Dr. Leonard J. Piccoli, president of the association, presided. Speakers at the dinner were Dr. Wilson G. Smillie, professor of public health and preventive medicine at the Cornell University College of Medicine; Dr. Harry Stoll Mustard and Commander C. S. Stephenson, an alumnus in charge of the Division of Preventive Medicine, Bureau of Medicine and Surgery of the United States Navy.

Professor Frederick G. Switzer, who has resigned as head of the department of mechanics in the Sibley College of Engineering at Cornell University to become a division engineer with the New York City Board of Water Supply, was honored by members of the faculty at a dinner on November 5 at Willard Straight Hall. Director William N. Barnard, of Sibley College, spoke of Professor Switzer's twenty-four years of service at the university, and Dean S. C. Hollister expressed the loss of the college at Professor Switzer's departure.

W. C. Browning, general manager of the Golden Queen Mining Company, Los Angeles, has been elected chairman of the western division of the American Mining Congress. He will serve for one year and will take charge of plans for the eighth annual metal mining convention and exposition of the division, which will be in San Francisco from September 29 to October 2.

Dr. J. C. Miller, assistant professor of animal industry at the Louisiana State University, has resigned to become professor of animal husbandry in charge of sheep work at the Texas Agricultural and Mechanical College.

Robert M. Salter, associate director and chief in agronomy of the Ohio Experiment Station and chairman of the department of agronomy at the Ohio State University, became director of the Experiment Station of North Carolina College on October 1. Dr. L. D. Baver, associate in agronomy of the Ohio Station and professor of agronomy at the Ohio State University, has been appointed associate director.

Eugene Schofield Heath, of Atlanta, has been made director of the new Georgia Botanical Garden which is in process of development on a four hundred and fifty-nine acre tract about eight and a half miles west of the business center of Atlanta. At present he is engaged mainly in the making of a species survey of the area.

Museum News states that Francis A. Young, who was acting director of the New England Museum of Natural History, Boston, during the absence last summer of Director Bradford Washburn, has been appointed assistant director.

Dr. Sidman P. Poole, associate professor of geology and geography at Syracuse University, major in the Army Reserve, has been called for duty in the Army Intelligence Division. He will be engaged in geographic work.

N. W. Pirie, Rockefeller demonstrator in the School of Biochemistry of the University of Cambridge, has been appointed head of the Biochemical Section of the Rothamsted Experimental Station.

The Lord President has appointed Dr. A. V. Hill, Foulerton research professor of the Royal Society; Sir Felix Pole, chairman of Associated Electrical Industries, and Sir Robert Robinson, Waynflete professor of chemistry at the University of Oxford, to be members of the Advisory Council of the Committee of the Privy Council for Scientific and Industrial Research. They succeed Dr. W. H. Mills, Professor A. Robertson, Sir Albert Seward and Sir Harry Shackleton, who have retired from the council on completion of their terms of office.

Dr. Hildrus A. Poindexter has recently returned to Washington after spending six months in South America and the Caribbean. Two months were devoted to visiting bacteriological and research laboratories in Brazil, Uruguay, Argentina, Chile, Peru, Ecuador, Republic of Panama and Caribbean republics. The other four months were spent in the study of protozoology at the School of Tropical Medicine at San Juan, Puerto Rico.

Dr. Kirtley F. Mather, professor of geology at Harvard University, was the guest of the department of geology and geography of the Michigan State College on November 19. In the afternoon he gave a lecture entitled "Plumbing the Depths of the Earth."

Dr. Harold W. Manter, professor of zoology at the University of Nebraska, gave the Sigma Xi lecture at the Iowa State College on November 4. He spoke on "The Galapagos Islands, with Special Reference to Their Biological Significance."

A lecture entitled "The Use of Isotopes in the Study of Metabolism" was given on November 19 by Dr. Rudolf Schoenheimer, associate professor of biological chemistry of the College of Physicians and Surgeons of Columbia University, before the Kappa Chapter of Sigma Xi of the university.

Dr. Cyril N. H. Long, Sterling professor of physiological chemistry at the School of Medicine of Yale University, delivered the fifth Renziehausen Memorial Lecture at the meeting of the Allegheny County Medical Society on November 19. His subject was "The Endocrine Control of Metabolism."

Bradford Washburn, executive director of the New England Museum of Natural History, will lecture at the museum on January 8 on "The Conquest of Mount Bertha." He will describe the Glacier Bay Expedition, during which he and his party camped for nearly a month among the mountains west of the bay, making the first exploration of the eastern ramparts of the Fairweather Range.

Professor Douglas Johnson, of Columbia University, on November 12 addressed the Science Association at Wesleyan University on "The Mysterious Craters of the Carolina Coast." Later the same evening he was a guest of the Honors College, where he talked informally on our current international problems. On November 15 he spoke before the Research Laboratory Colloquium of the General Electric Company at Schenectady on research in the natural sciences, with illustrations from studies of the Carolina "bays."

Dr. R. Ruggles Gates, professor of botany in the University of London, lectured recently at the University of Colorado, the University of Denver and the University of Utah on "The Significance of the Blood Groups." He also gave lectures and addresses at the University of Denver on "The Amazon," on "India," on "Recent Progress in the Study of Evolution" and on "The Nature of Racial Differences in Man." He plans to lecture at the University of California in the departments of botany, zoology and anthropology, and in the Medical School and the School of Agriculture.

The annual dinner and meeting of the New York Academy of Sciences will be held on the evening of December 11. It is requested that those planning to attend assemble at the Broadway Theater, Fifty-third Street and Broadway, at six-thirty o'clock, where a preliminary showing of "The Origin of the World and the Evolution of the Dinosaurs" from the "Rite of Spring," a fantasia by Walt Disney, will be presented by courtesy of the Walt Disney Productions. "The Methods of Walt Disney Productions" will be demonstrated by Barnum Brown, of the American Museum of Natural History, immediately after the annual dinner. An address entitled "Biological Bases of Democracy" will be made by Dr. Edwin Grant Conklin, professor of biology emeritus of Princeton University and executive vice-president of the American Philosophical Society. Following Dr. Conklin's address, Dr. Harold E. Vokes, who returned recently from the French mandates of Syria and Lebanon, will describe his experiences there. His address will be entitled "Around the War to Syria and Lebanon." It will be illustrated by color motion pictures and lantern slides, which will be shown for the first time at the dinner.

The seventh annual meeting of the American Academy of Tropical Medicine was held on November 14, in conjunction with the American Society of Tropical Medicine, meeting with the Southern Medical Association in Louisville, Ky. The presidential address, entitled "Some Contributions of United States Naval Medical Officers to Science," was delivered by Dr. Charles S. Butler, Rear Admiral, Medical Corps, U. S. Navy, Retired. The following officers were elected for the year 1941: *President,* Dr. Marshall A. Barber; *Vice-president,* Dr. Herbert C. Clark; *Secretary,* Dr. Ernest Carroll Faust; *Treasurer,* Dr. Thomas T. Mackie; *Councilor* (5-year term), Dr. L. L. Williams; *Councilor* (3-year term), Dr. Harold W. Smith.

According to *Museum News,* the Michigan-Indiana-Ohio Museum Association has been reorganized and the name has been changed to the Midwest Museums Conference of the American Association of Museums. The Wisconsin Museum Association is taking action to join, and museums in Illinois, Missouri, Minnesota and Rochester, N. Y., are also affiliated with the conference. Dr. Carl E. Guthe, director of the University Museums of the University of Michigan, has been elected president.

The Rockefeller Foundation has made a grant of $17,000 to support the researches of Dr. Peter J. W. Debye, professor of chemistry at Cornell University.

The Charles W. Hargitt research fellowship in zoology at Duke University becomes available for the year 1941–1942. The fellowship, which carries a stipend of $1,000, is restricted to research work in the field of cytology. It is open to those who have already received their doctor's degree and have worked in this field. Appointment is for a single year with the possibility of reappointment; no teaching or assistance is required of the holder of the fellowship. Applications must be made before March 1, accompanied by statements of investigations, publications or work in progress. Inquiries and applications should be sent to Dr. Geo. T. Hargitt, Biology Building, Duke University, Durham, N. C.

THE geological courses at Upsala College, East Orange, N. J., have been discontinued. Its geological collections have been divided among the U. S. Military Academy, the Smithsonian Institution and the Massachusetts Institute of Technology.

Museum News states that in acordance with a measure passed by the City Council in August the Cleveland Museum of Natural History took over control of the Brookside Park Zoological Garden in Cleveland at the beginning of October. Harold T. Clark, president of the museum, invited thirty citizens of Cleveland to serve on a board of control for the zoo. The museum now has control of the Holden Arboretum, the trailside museums in the parks and the Zoological Garden. The contract with the city provides that the mayor, director of public properties and president of the City Council be members of the board of trustees. The city provides $50,000 annually for the operation of the park by the museum, provides repairs and policing and furnishes public utility service without cost. The museum is given full authority to manage and develop the garden.

GLENCOE, a seven-acre estate at Irvington, N. Y., valued at $50,000, and originally a part of the Alexander Hamilton family holding, has been given to Columbia University by Mr. and Mrs. John W. Donaldson, of Millbrook, N. Y. It will become part of the arboretum being developed for use by students in landscape architecture at Columbia. Glencoe borders Nevis, the sixty-eight acre estate presented to the university in 1935 by the late Mrs. T. Coleman du Pont, of Wilmington, Del., widow of the former United States Senator from Delaware and mother of Mrs. Donaldson. The grounds of Glencoe will be adapted to the general scheme of the Nevis Arboretum.

THE Board of the Nobel Foundation at Stockholm, on October 11, asked the Swedish Government to allow a postponement in conferring the 1940 Nobel Prizes for literature, physics and chemistry until the 1941 prizes are conferred. The prize in physiology and medicine has also been reserved until 1941 by the Faculty of the Carolean Medico-Surgical Institute in Stockholm. The Peace Prize, which the Nobel Committee of the Norwegian Storting has to confer, also can not, for obvious reasons, be conferred this year.

DISCUSSION

PROBLEMS OF AGING

THE NATIONAL INSTITUTE OF HEALTH of the United States Public Health Service is organizing a new unit for research into some of the many problems of aging. With the conspicuous shift to greater age in the population, senescent individuals are becoming increasingly significant in the national economy and defense. Preventive medicine must attack the practical problems of the rising proportion of deaths attributable to diseases of middle and later life and energetically attempt to augment the health and vigor of those past the meridian. Aging is a continuous biologic phenomenon which starts upon creation of a new individual and continues at variable rates until death. The problems of aging (gerontology) are not limited to the diseases of the aged (geriatrics), for the latter are the consequences of senescence. In man, probably the most significant period of life for gerontologic study is late maturity, approximately the two decades between 40 and 60.

The problems of aging are logically divisible into three major fields of investigation: (1) the biology of senescence as a process, (2) the human clinical problems of aging and of diseases characteristically associated with advancing years which include the mental changes of senescence and senectitude as well as the physical changes, and (3) the socio-economic problems of a shifting age distribution in the population. The National Institute of Health is concerned with the first two of these divisions of the science.

In order to advise this new unit, there has been formed a National Advisory Committee on Gerontology, representative of the scientific thought of the nation. The membership of this advisory committee includes: L. R. Thompson, director, National Institute of Health, U. S. Public Health Service; Anton J. Carlson, physiologist, University of Chicago, National Research Council; Charles L. Christiernin, Association of Life Insurance Medical Directors of America; medical director, Metropolitan Life Insurance Co.; Robert A. Coker, zoologist, University of North Carolina; William Crocker, botanist, Boyce Thompson Institute for Plant Research; Lawrence K. Frank, sociologist, Josiah Macy, Jr. Foundation; A. Baird Hastings, biochemist, Harvard University; Ludvig Hektoen, pathologist; consultant, National Cancer Institute, U. S. Public Health Service; Winfred Overholser, psychiatrist, superintendent, St. Elizabeths

Hospital; Clarence Selby, industrial physician, General Motors Corporation; William D. Stroud, clinician, Philadelphia, Pa.

The first service to scientific research which the unit on gerontology is undertaking is to conduct a survey of the present trends of active and contemplated investigations into the problems of aging in American scientific institutions. This survey is intended to ascertain just what problems are being studied and what methods of approach are being applied. There is no desire to learn, in advance of publication, the data being developed in these specific undertakings.

In addition to these studies, many investigations which do not pertain directly to aging should yield data useful to workers in gerontology. The unit on gerontology is especially interested in knowing of these indirectly related studies, the full implications of which are far too often obscured in their published titles.

Inquiries about studies related to aging are being sent to scientists in the basic biologic sciences as well as to clinical investigators, for much fundamental work upon the processes, mechanisms and consequences of senescence is probably going on in the sciences of botany, zoology, physiology, pharmacology, psychology, etc. From the clinical viewpoint, our greatest concern is with those studies dealing with health evaluation, mensuration of functional capacity (including criteria of "physiologic age") and with those diseases whose incidence increases sharply in later life (the so-called "degenerative disorders").

Critical analysis of the information elicited by such a survey may be expected to serve several valuable purposes. It should assist in bringing together in closer cooperation investigators interested in related problems, especially when widely divergent methods of approach are being utilized. The survey will likewise emphasize the urgent need for greatly augmented support for significant studies of these vitally important problems of senescence.

The broad and general pattern of the problems being investigated will undoubtedly reveal a number of neglected "blank spots" which may justify special emphasis in the future. Analysis of the data of the survey will also be an invaluable aid in formulating future research programs, both at the National Institute of Health and elsewhere.

From preliminary inquiries it is observed that there is a great but largely latent and scattered interest in the problems of aging. It is the hope of the unit of gerontology of the National Institute of Health that the present survey may serve to effectively aid the promotion of closer cooperation of the scientists interested in these fields.

Information concerning subjects under investigation and the methods of approach is earnestly solicited.

DR. EDWARD J. STIEGLITZ

U. S. PUBLIC HEALTH SERVICE,
BETHESDA, MD.

SHALL ZOOLOGY REVERT TO THE TIME OF LINNAEUS?

WHEN I read "A Short Zoology of Tahiti in the Society Islands," by Anthony Curtiss,[1] it was clear to me that others would feel as I did when I placed it back on my library shelf.

This little book contains six chapters, namely, mammals, birds, reptiles, fishes, insects and worms and in its classification of these reverts to the time of Linnaeus about 1758.

The attitude and cultural approach to the zoology of Tahiti may be gained from the first two paragraphs of the Introduction:

> Zoology is the study of animal life, as distinguished from botany (the study of plants) and mineralogy (the study of minerals). It is a branch of learning that has interested many of the so-called scientists, because by means of a distortion of it they hope to prove many theories of theirs. As all persons who are virtuous and honest must desire to disprove the distorted and mistaken notions taught by the professors and blindly and superstitiously received by their pupils, it is well that some people should study zoology and report their findings. This little book is only a small beginning; in my greater zoology I shall disprove more of their fables. . . . Too great a use of little understood words, and the employ of too involved a system of classification, are the marks of collegiate duncery. But we need some system, for the sake of convenience, and some technical words, for things having no ordinary names.
>
> As for the system, I use a modified form of the system of Linnaeus, who gave us the binomial (two-term) system that most ''scientists'' pretend to follow, though they have befogged it with many unconvincing modifications of their own. For instance, they will tell you that spiders and crabs are not insects. Linnaeus, the first to use the word *insecta* in a scientific sense, used it to include all animals having jointed legs. Even the ''scientists'' admit that spiders, crabs, etc., belong to one group, to which insects (as they restrict the term) also belong; they call this group *arthropods*. But why not use the old Linnaean word *insects*, that everybody understands? I suppose that they do not use it, because they imagine it sounds better to use fancy Greek words that few people know.

Chapter V, on insects, is somewhat more inclusive than the heading suggests as judged from the following quotation, p. 140:

> Following the system of Linnaeus, which is easier to understand than the wild nonsense of the ''scientists,'' I shall include under the term *insects* all those animals

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[1] Brooklyn, N. Y.: Guide Printing Company, pp. xvi + 193, 1938.

> (moving forms of life) that have no backbone, yet, in their adult stage at least, have jointed legs; while I shall consider as *lower forms of life, or worms*, as Linnaeus calls them (Vermes), those that have neither backbones nor (in their adult stage) jointed legs.

On pages xv and xvi he states:

> The system I follow is that of Linnaeus, a little modified, as in the fourth edition of my little New England zoology; but this is the first time I have brought Linnean, that is, binomial technical names, into the text of my work. If I use the word *family*, as I may from time to time, I always mean the *genus*, in the binomial sense, as used in Linnaeus. With that other invention, the non-Linnean family, with its everlasting *-idae*, and her sister *-inae*, I have nothing to do. This *-idae* and *-inae* are tag ends that the "scientists" hang onto genera to make up super-genera such as good old Linnaeus never heard of.

This book will cause zoologists much concern because many new binomial names are published with descriptions. Among the fishes (listed on pp. 32–139) only six previous Linnean names were used, and 120 new binomial names are introduced. Many new names are given for the other animals described, probably all of which will be included with the list of synonyms for well-known species of Tahiti. This has been done by Henry W. Fowler for the fishes in a forthcoming publication of his. Curtiss, apparently unacquainted with the extensive zoological literature on South Pacific animals, gave new names to those living around Tahiti because suitable ones were not printed in 1758, and later works are unknown to him.

LEONARD P. SCHULTZ

PALEONTOLOGICAL DISCOVERY IN SIBERIA

A FEW days ago the undersigned received from the U.S.S.R. Society for Cultural Relations with Foreign Countries, in Moscow, the following translation of a recent report on a rare paleontological find in Siberia, which may be of wider interest. It reads as follows:

NOVOSIBIRSK, SEPTEMBER 19

Members of the Komsomol Young Communist League of the "Iskra" Collective Farm discovered the complete skeleton of an ancient fossil animal in a layer of black silt at a depth of six meters. This discovery was made on the bank of the small river Oyesh, near the village of Vakhrushevo, eighty kilometers from Novosibirsk. The skeleton has been handed over to the Novosibirsk Museum, where it has been restored. Scientists have now established the fact that this is a skeleton of a representative of a large species of fossil elephant (*elephas antiquus*) which, in the early glacial epoch, was of wide occurrence. This elephant is one of the predecessors of the mammoth and differs from it by a lesser curvature of the tusks.

In spite of the young age of this elephant, as is evidenced by the jaws and the non-ossified cartilage parts of the body, the height of the skeleton is 270 cm, its length, to the base of the tusks, is 325 cm, the length of the tusk is 150 cm. The skull is smaller than that of a mammoth. The upper and lower jaws of the unearthed specimen have four teeth each.

Scientific workers have left Novosibirsk to study the layer of soil where the elephant was imbedded. . . .

In an interview with a *Tass* correspondent, Academician A. A. Borisyak, director of the Paleontological Institute of the Academy of Sciences of the U. S. S. R., stated the following:

"The skeleton unearthed near Novosibirsk is of outstanding scientific value. This is the first discovery in the Soviet Union of an entire fossil elephant referring to the beginning of the Quaternary period. Hitherto we could judge of such elephants only by separate teeth which were found."

Upon learning of this valuable discovery the Paleontological Institute communicated with the Novosibirsk Museum and intends to send there a scientific collaborator in order to study this specimen of *elephas antiquus* on the spot.

A. HRDLIČKA

U. S. NATIONAL MUSEUM

SCIENTIFIC BOOKS

FLORA OF INDIANA

Flora of Indiana. By CHARLES C. DEAM. 1236 pp. 2247 maps. Indianapolis: Department of Conservation, Division of Forestry. 1940. $3.50.

THIS impressive volume represents the work of many years, as the distribution maps of individual species of flowering plants and ferns attest. It will undoubtedly serve as the model for state floras of the future, and the numbering of genera according to the system of Dalla Torre and Harms provides for interpolation of genera as one wishes. Conversely, the "Flora of Indiana" provides a background for arranging genera in the herbarium in a systematic rather than an alphabetic way. Indiana includes a large proportion of the species of eastern United States, and the comprehensive text references make it a sort of dictionary for the latest recognized names and their place of publication. Nothing, it seems, has been forgotten in making the work complete. There are keys to families and genera, summaries of the herbaria examined, statistical accounts of collectors in Indiana, glossaries, a register of obsolete locality names, and so on. The thirty-six pages of introduction to the main catalogue of plants include an account of seven recognized plant areas of Indiana: the Dune Area along the shores of Lake Michigan; the Lake Area in the north, characterized by many plants of the coastal plain; the Tipton Till Plain, composed of flat lands extending south to the limit of Wisconsin drift, in which native plants have been almost exterminated by agriculture; the Illinoian Drift, south of the Tipton Till, including ravines, oak flats and sandy terraces; the Prairie Area, now chiefly in the northwest; the Lower Wabash Valley, often inundated, and the northeastern limit of many species of the Mississippi Valley; the Unglaciated Area, with chestnut oak and accompanying species which have penetrated across the Ohio River. Statistics show 1,838 native and 302 introduced species, with many additional varieties and forms. Notations on the period of flowering, comparative morphology under varying habitat, behavior of species under cultivation and rate of increase of introduced plants provide much of interest to the amateur. Thus of *Ampelamus albidus* (p. 769) we read: "The beekeepers widely publicized this plant as an excellent honey plant under the name of bluevine. We introduced it for this purpose at Bluffton and some seed escaped and we have been trying to exterminate it now for eight years without success."

One of the most interesting passages in the book will be found on pages 1125 to 1129, where detailed explanation is given of habitat terms such as "slough," "bog," "pond" and "prairie."

The eighty-seven pages of excluded species (more than 700 items) represent previous incorrect determinations, unsubstantiated records, etc., and reveal the pitfalls which beset the careful worker. The "Flora of Indiana" upholds Dr. Coulter's statement in the preface: "It is safe to say that in no other regional Flora has such meticulous care been taken to secure absolute accuracy in determination, as well as the very latest word in these special studies."

Henry K. Svenson

Brooklyn Botanic Garden

LAND MOLLUSCA OF NORTH AMERICA

Land Mollusca of North America (North of Mexico). Vol. 1, Part 2. By Henry A. Pilsbry.[1]

It was my pleasure to review in Science (Vol. 91, No. 2360, pp. 292–293) Vol. 1, Part 1, of this important publication. I refer the reader of the present note to that review, in which the scope, significance, as well as the timeliness of this endeavor are discussed.

In Part 2, which covers the families Polygyridae and Sagdidae, the author has employed the same thoroughgoing methods that he employed in Part 1.

Students of North American land mollusks will here find keys to assist in quickly locating their species in the proper superspecific categories adopted in the present system, as well as adequate text and illustrations for the determining of the species and subspecies themselves.

Table I is in continuation of the one published for Part 1 and briefly calls attention to the strides that have been made since Binney published his Memorial volume in 1885, and also the significant part that Dr. Pilsbry has played in bringing our knowledge of the subject to its present status.

TABLE I

	Species older than 1885	Species here accepted	Subspecies here accepted	Pilsbry's species	Pilsbry's subspecies
Family V. POLYGYRIDAE					
subfamily Polygyrinae					
Genus Polygyra					
Subgenus Polygyra	2	2	5		
Subgenus Daedalochila	18	21	20	2	10
Genus Stenotrema	10	24	13	9	3
Genus Praticolella	5	7	7		1
Genus Mesodon					
Subgenus Mesodon	12	19	18	3	9
Subgenus Patera	2	6			3
Subgenus Appalachina	1	2		1	
Subgenus Inflectarius	2	4	4	1	
Genus Trilobopsis	1	5	6	2	3
subfamily Triodopsinae					
Genus Triodopsis					
Subgenus Triodopsis	4	11	19	2	9
Subgenus Xolotrema	3	4	5		1
Subgenus Neohelix	4	4	4		1
Subgenus Cryptomastix	5	8	10	1	6
Genus Allogona					
Subgenus Allogona	1	2			
Subgenus Dysmedoma	2	2	2		
Genus Vespericola	2	6	8		2
Genus Ashmunella	1	27	39	14	25
Family VI. SAGDIDAE					
subfamily Sagdinae					
Genus Lacteoluna	1	1			
subfamily Thysanophorinae					
Genus Hojeda	1	1			
Genus Thysanophora					
Subgenus Thysanophora	2	2			
Subgenus Lyroconus	1	1			
Genus Microphysula	1	2	2	1	1
Total of Part 2	81	161	162	36	74
Contents of Part 1	53	188	210	66	97
Total for the two parts	134	349	372	102	171

These volumes are spans in the bridge that will easily carry the student of North American mollusks from the distant 1885 to the present without going through the gigantic task of bridging the gap personally.

I am sure that all of us pursuing this branch of science will voice gratitude and appreciation to him, his associates and the powers that be at the Academy of Natural Sciences of Philadelphia for the service that they have rendered us.

Paul Bartsch

U. S. National Museum

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[1] 1940. Monograph No. 3. The Academy of Natural Sciences of Philadelphia. pp. vi + 575–994, index, ix pp., 208 text illustrations, about 1,500 figures. $7.50 to subscribers of complete set; separate, $10.00.

THE NATIONAL ACADEMY OF SCIENCES

ABSTRACTS OF PAPERS

(Continued from page 484)

The ballistocardiograph, a new means of investigating the heart and circulation of man: ISAAC STARR (introduced by A. N. Richards). When physics and chemistry changed from descriptive and qualitative methods to quantitative methods, the rate of advance was tremendously accelerated. The investigation of disease has been largely descriptive and qualitative up to the present time, but there has been an ever-increasing group of workers attempting to design and apply quantitative methods to the host of problems encountered in the clinic. This presentation is a progress report of an attempt to get quantitative information about one of the commonest problems in medicine, the question of the strength or of weakness of the heart and circulation. The heart is a pump and to properly assess its function the amount of blood pumped per unit of time must be known. Methods designed to estimate the cardiac output of man have been developing since 1909. The field has been handicapped by the impossibility of testing methods by estimating known quantities, but the best methods now yield consistent results, and agree fairly well with one another. But all these methods, either because of the need for cooperation on the part of the subject, or because they incited fear or caused discomfort or pain, or because of the laboriousness of the procedure, have not been suitable for routine use in the clinic. The ballistocardiograph is suitable for such use, for it requires nothing of the subject save that he lie relaxed on the table and rough estimations of cardiac output can be made by the operator in a few minutes. The apparatus consists of a table suspended from the ceiling on wires and braced to prevent motion in any but the longitudinal direction. Motion in that direction, opposed by a strong spring, is magnified several thousand times and photographed. When a subject lies on the table it moves in time to the beating of his heart. The forces producing this motion are chiefly the recoil as the blood starts headward when the heart contracts, and the impact as this headward motion is arrested at the aortic arch and pulmonary bifurcation. Unfortunately the resultant of these forces is not perfectly reproduced in the record, for they pass through body tissues which, jelly-like, quiver for a brief instant after receiving a single blow. Therefore after-vibrations warp the latter part of the record, but they have much less effect on the early waves and from this part reasonably reliable data can be obtained. For this and other reasons I do not believe that the method will ever be one of the highest precision; its importance is in the ease of its application and in the fact that it gives to clinicians some knowledge of fundamental facts of cardiac function about which the ordinary clinical methods leave them ignorant. Evidence has been secured that the size of the early ballistic waves is related to the output of the heart, that their shape is conditioned by the changes in the velocity of blood during its ejection from the heart. Normal standards have been ascertained by examination of over 300 normal subjects. The method makes possible the routine examination of patients and provides evidence of cardiac health or disease of a type not available before. It will also detect abnormalities of the circulation not associated with heart disease, a condition which has often entirely escaped detection heretofore. The method is particularly adapted to assessing changes in cardiac function in single individuals. Experiments have been carried out on the effects of exercise, drugs and other therapeutic agents on cardiac function, and also on the development and healing of disease.

The interaction of tones in the ear: ERNEST G. WEVER. When two or more tones are applied simultaneously to the ear they interact in a complex manner and give rise to phenomena not represented in the physical stimuli. Some of these phenomena—beats, combination tones and masking—have already been recognized in subjective observations. A new phenomenon, called tonal interference, is revealed by the electrical responses of the cochlea. Tonal interference appears as a reduction in the magnitude of response to a given tone due to the presence of another tone. It is distinct from masking: it has a different locus in the auditory mechanism, and it occurs for tones of any frequency. An experimental analysis shows the character of the interference process and its relations to the stimuli; and, more generally, it gives insight into the nature and order of events in the cochlea in response to sound. The experiments were carried out in collaboration with C. W. Bray and M. Lawrence.

The rôle of the carotid and aortic bodies in the defense of the mammalian organism against oxygen lack: CARL F. SCHMIDT and JULIUS H. COMROE (introduced by A. N. Richards). The carotid and aortic bodies consist essentially of glomus tissue, *i.e.*, they are structures in which arteries break up into thin-walled sinusoidal spaces devoid of muscular coat and in which the pressure must be close to the arterial level. The walls of these spaces contain abundant nerve endings, and the specialized function of the structures depends on the fact that these nerve elements are stimulated by certain changes in the chemical composition of the blood, giving rise to reflexes that strongly stimulate the medullary centers (respiratory, vasomotor, cardioaccelerator, cardioinhibitory); under some circumstances generalized motor activity of the central nervous system (convulsions) may thus be produced. The stimuli by which the chemoreceptors are stimulated include all the conspicuous changes produced in the blood by increased metabolic activity, *i.e.*, increased carbon dioxide tension, decreased oxygen tension and increased acidity. A considerable number of drugs can also stimulate them; most of these can be grouped in two categories: first, those that turn the balance between the demand of tissues for oxygen and the available supply of it in the direction of a deficiency of oxygen (inhibitors of oxidations such as cyanides and sulfides; stimulators of metabolism such as dinitrophenol and dinitrocresol); second, those that have "nicotinic" actions (nicotine, lobeline, coniine, choline and its derivatives, etc.). The significance of these reflexes to the organism probably depends on their being relatively primitive and undifferentiated survivors in an air-breahting mammal of a reflex system originally intended for orienting a gill-breathing forbear in an aquatic environment. The neurons of the medullary centers (particularly the respiratory) of terrestrial mammals have developed a highly specialized sensitivity to carbon dioxide, but although some observers have claimed that the chemoreceptors are even more sensitive, the balance of experimental evidence now available indicates that in the normal mammal the chemoreceptors are distinctly less sensitive than the center to carbon dioxide. On the other hand, recent evidence indicates that the center is much less sensitive to H^+ ions, and the chemoreceptors considerably more sensitive to them, than had been supposed; it now seems possible that the H^+ ion does not stimulate the respiratory center directly, the responses to this stimulus being due to the effects of the increased CO_2 tension on the center and to the action of the H^+ ions on the chemoreceptors. One of us (J. H. C.) is now investigating the sensitivity of the respiratory center to carbon dioxide and to acids introduced directly into its tissues; so far, although carbon dioxide has regularly stimulated the center, acids (hydrochloric, lactic) have shown no signs of a similar capacity, but the experiments are still in progress and no final statement can be made at this time. The chemoreceptors are definitely responsible for most if not all of the stimulant effects of oxygen deficiency (the hyperpnea, hypertension and tachycardia and perhaps the convulsions also); this is also probably true of the corresponding effects of nicotinic drugs, excepting the hypertension that such drugs can produce by ganglion stimulation. Thus these reflexes are responsible for most of the organism's defense against anoxia; as far as is now known, the direct effects of anoxia on structures other than the chemoreceptors is a depressant one; resistance to the depressant effects of anoxia is probably the most important attribute of this reflex system, and this is probably referable to the relatively undifferentiated state of the chemoreceptors. When the specialized sensitivity of the central neurons is reduced (as by anesthesia) the control of breathing may revert to the primitive aquatic type and be carried out by the chemoreceptors, responding to deficiency in the oxygen tension of arterial blood rather than to increase in the CO_2 tension; under such circumstances relief of anoxemia may cause respiratory failure. In some cases of sudden relief of long-standing tracheal obstruction and perhaps of sudden increase in the oxygen intake by aviators at high altitudes, collapse and unconsciousness ensue, perhaps for a similar reason.

Some effects of low concentrations of copper salts on the mammalian red blood cell: MERKEL H. JACOBS and W. D. JONES. It was previously reported by Jacobs and Corson that concentrations of copper salts of the order of magnitude of 10^{-8} molar, or even considerably less, have a highly characteristic inhibiting effect on the hemolysis, in solutions of glycerol, of the red blood cells of certain mammals, especially man. This effect has been further investigated by a non-hemolytic method involving osmotic volume changes of the cells under more normal conditions, and has been shown to be essentially one of cell-permeability to glycerol. Though it can be imitated in some respects by salts of mercury, in others it seems to be unique, and it suggests a possible delicate non-chemical method which might be used under certain conditions, yet to be exactly defined, for the detection of traces of copper. The available evidence indicates that the action of copper is at the surface of the cell rather than in its interior; the minimum amounts required are so small that only a fraction of the cell surface could be occupied by copper atoms at any one time. Within the limits of accuracy of the method, the effects of copper seem to be practically instantaneous; by photographic recording the full degree of inhibition of osmotic swelling can be shown to appear in less than a second. At the concentrations used the effects are also rapidly reversible, either by washing the cells, diluting the external medium beyond a certain critical point, raising the pH (with results that differ with different species) or, most conveniently, by the addition of a trace of serum or of hemolyzed cells. The latter method is well suited to photographic recording, and permits the demonstration of a restoration of the normal permeability of copper-treated cells in as short a time as one second.

A comparison between splenic and normal erythrocytes: ARTHUR K. PARPART (introduced by E. N. Harvey). One of the chief functions of the spleen is the storage of blood cells. Previous experimental work has suggested that erythrocytes, thus stored, undergo degenerative changes. The nature of these alterations was not known. Recent investigation has clearly demonstrated that erythrocyte degeneration in the spleen is associated with marked changes in the red cell membrane. A comparison has been made between the permeability of erythrocytes from the splenic reservoirs and those from the normal circulation. The permeability to lipid-soluble and lipid-insoluble compounds and to ions has been found to be much greater in the case of red cells stored in the spleen. These observations suggest that there must be some changes in either the chemical composition or the molecular configuration of the red cell membrane, or both. Lipid analyses have shown that the total lipid content of the membrane decreases. At the same time the lipoprotein complexes in the membrane are decreased. These data have an interesting bearing on the relation between permeability and the chemical composition of the red cell membrane. They are the first records of a normally occurring change in the membrane composition which is correlated with a change in permeability. Previous experience with variations of lipid content of red cell membranes in relation to their permeability made it reasonable to expect that the decrease in lipid content of splenic red cells would not have affected their permeability so markedly. There remains the, as yet uninvestigated, possibility that the orientation of the molecules in the red cell membrane is an important factor in the altered permeability of splenic red cells. Investigations are in progress concerning the enzymatic agent which is responsible for the changes in the chemical composition of red cells stored in the spleen.

Pituitary diabetes in the cat; recovery after insulin treatment: F. D. W. LUKENS and F. C. DOHAN (introduced by A. N. Richards). Pituitary-diabetes is the permanent diabetes produced by the injection for a few weeks of crude saline extract of anterior pituitary glands.

This was first described by Dr. F. G. Young, of London, who used normal dogs; he could not make normal cats diabetic. We have likewise failed with the intact cat, but have found that by the removal of part of the pancreas (leaving enough to prevent any signs of diabetes), this species is rendered susceptible to pituitary extract. A number of permanently diabetic cats have thus been prepared. They manifest the same type of diabetes observed in the dog as measured by the blood and urine sugar, but the pancreatic islands (the source of insulin) present a type of abnormal appearance (hydropic degeneration) which is different from that in the dog (atrophy). In the cat anatomical and functional restoration of the islands takes place under insulin treatment, and the recovery of the animal is maintained after the withdrawal of insulin. Recovery does not occur in animals in which the diabetes has lasted for five months, and no recovery has been reported in pituitary diabetic dogs treated with insulin. The relation of various factors to the recovery of damaged islands of the pancreas in the diabetic animal can thus be studied. Species difference, the type of anatomical disorders, the duration and severity of the diabetes and the variations of treatment are under investigation.

The tetramite stage of Orthopteran auxocytes: C. E. McClung. During the development of the male germ cells of the grasshopper a critical stage is reached during which equivalent contributions by the male parent and the female parent are brought into intimate physical contact and there react upon each other so as to bring about new combinations in the character controls of the two. This seems to be the most significant feature of biparental reproduction, and every detail of the phenomena of germ cell production at this time is of great theoretical importance. Because these details concern very minute elements of the cell exact determinations of their behavior are difficult to arrive at. It is, however, now generally agreed that the chromosomes, the cell elements which carry the material genetic controls, are greatly elongated and lie parallel with homologous regions apposed. Just how the exchange of units, representing genetic controls, is accomplished, is not completely understood. One significant stage of the process is of very short duration and has not previously been described. At this time the four strands of each chromosome, two from each parent, lie extended and parallel with each other, without the presence of any of the so-called chiasms which have been credited by some as the means by which these threads are held in contact. Various other assumptions of "attraction" and "repulsion," "precocity," etc., are definitely disproved by the existence of the "tetramite," a chromosome in the form of four parallel threads.

Biographical memoir of Harvey (Williams) Cushing: W. G. MacCallum.

Biographical memoir of Calvin Blackman Bridges: T. H. Morgan.

Biographical memoir of Arthur Edwin Kennelly: Vannevar Bush.

Biographical memoir of Floyd Karker Richtmyer: Herbert E. Ives.

Biographical memoir of Albert Sauveur: Reginald A. Daly.

SPECIAL ARTICLES

ATTENUATION OF CELL STIMULATING BACTERIA BY SPECIFIC AMINO ACIDS[1]

Factors influencing virulence have been studied as part of a larger program aimed at clarifying the means whereby the crown gall organism, *Phytomonas tumefaciens* (Smith and Town.) Bergey *et al.*, incites diseased growth in plants. After a considerable range of toxic substances and unfavorable conditions failed to change pathogenicity, glycine proved effective. Attenuation was accomplished by 20 to 30 transfers in a mannitol nitrate mineral salts medium containing .1 to .3 per cent. glycine adjusted to pH 6.8. The amount of glycine was increased gradually in successive transfers, according to the tolerance of the culture, so that growth was slow. Attenuation was considered complete when puncture inoculations into tomato failed to induce crown gall. Several original strains have been kept in culture for over ten years without loss of virulence. Mechanically picked single cell cultures were isolated at the beginning, at various intermediate stages and at the end to avoid any differential selection in an originally mixed bacterial population.

Some attenuated cultures when placed on yeast infusion mannitol medium regained virulence within a year. Others remained attenuated even after four years. The permanency of attenuation was partially dependent upon the number of transfers in glycine medium after attenuation.

The reaction of the medium affected the rate of attenuation. A medium at pH 8.0 was inhibitory and readily attenuating, while one at pH 5.0 was not.

Various other compounds having structural similarity to glycine have also been employed. Among over 50 compounds most of the amino acids were included. With the exception of dicyandiamid (which gave only partial attenuation) and the dipeptide of glycine, all the attenuating compounds were amino acids. These were: glycine, alanine, serine, alpha amino n-butyric acid, threonine, valine, norvaline, methionine, leucine, norleucine, isoleucine and lysine. Their relative effectiveness in mannitol-nitrate-mineral-salts solution is indicated in Fig. 1. Only racemic mixtures of opti-

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[1] Published with the approval of the director of the Wisconsin Agricultural Station. This work was supported in part by the International Cancer Research Foundation and the Wisconsin Alumni Research Foundation. Assistance in testing these materials was furnished by the personnel of the Works Projects Administration, official project no. 65-1-53-2349.

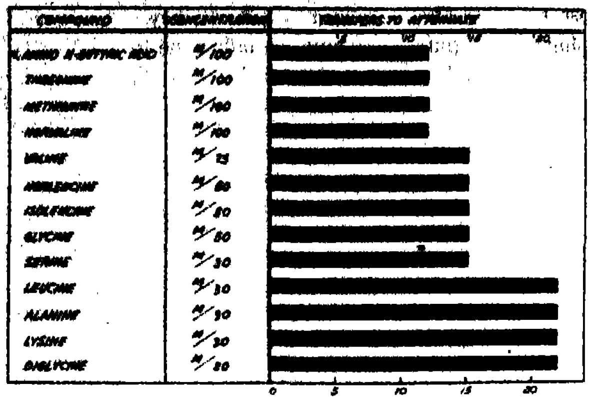

FIG. 1. Attenuating compounds, concentrations used in mannitol-nitrate-mineral-salts medium, and number of successive transfers necessary to attenuate single-celled virulent crown-gall cultures. The concentrations given were the highest used.

cally active amino acids were studied except with leucine. In this case both the l- and dl-compounds were found active. Except for phenylalanine there was direct correlation between inhibition of bacterial growth and attenuation.

Thus all the attenuating amino acids were aliphatic in nature. With the exception of lysine they contained only single amino and carboxyl groups. The other diamino mono-carboxylic acids, the mono-amino dicarboxylic acids and the cyclic amino acids were inactive. Although glycine was active, the ethyl ester of glycine, the anhydride of glycine and sarcosine were inactive. This indicated that the free amino and carboxyl groups might be required for attenuation. Also since diglycine was less effective than glycine and triglycine was inactive the length of peptide chain appears influential.

Glycine and alpha amino n-butyric acid did not specifically inhibit glucose or succinate dehydrogenase, aspartic acid deaminase or aerobic respiration in the Warburg respirometer. The active amino acids likewise did not specifically inhibit the peptidases splitting leucylglycine, leucyldiglycine or alanyldiglycine.

Over 1,000 attenuated cultures have been produced during these studies.

The details of these investigations will be published elsewhere. Meantime, this preliminary statement is given because of its bearing on such basic problems as (1) the attenuation of pathogenic bacteria, (2) the physiological specificity of the amino acids and (3) the mechanism of atypical and pathological cell growth.

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LOCALIZATION OF CHOLINE ESTERASE IN NERVE FIBERS

RECENT investigations have revealed that choline esterase is highly concentrated in all nerve fibers, but rises to strikingly high concentrations at synapses and motor end plates.[1, 2] Previous observations on the superior cervical ganglion of cats, after section of preganglionic fibers, and on denervated muscles of guinea-pigs[3] suggested strongly that the enzyme may be concentrated at or near the surface of nerve cells. In these experiments the concentration in preganglionic fibers inside the ganglion appeared to be several times as high as the concentration in the same fibers before they enter the ganglion. This increase was interpreted as possibly being connected with the increase of surface due to the extensive end-arborization of preganglionic fibers in this ganglion.

Direct evidence that choline exterase is highly concentrated at or near the surface of nerve fibers has now been obtained. The enzyme activity has been determined separately in the axoplasm and the sheath of the giant fiber of the squid (*Loligo paealii*). The method used was the Cartesian diver technique as developed by Boell, Needham and Rogers.[4]

Practically the total enzyme activity is found in the sheath, whereas the amount of enzyme present in the axoplasm is negligible. The figures obtained in one experiment are given in Table 1.

TABLE 1

	Material in mg fresh weight per diver	Output of $CO_2 \times 10^3$ cmm in 160 min.	$Q_{CH \cdot E}$·* (average)
Whole axon	0.123 0.123	53 69	0.150
Sheath	0.09 0.09	135 115	0.420
Axoplasm	0.20 0.20 0.20	8 28 18	0.027

* $Q_{CH \cdot E}$· = mg. ACh split by 100 mg tissue in 60 min. t = 27.5° C.

As at least 80 to 90 per cent. of the sheath is connective tissue,[5] the values obtained for the sheath have to be multiplied by at least 5 to 10 times. The enzyme concentration may be actually much higher than the activity per unit of tissue weight indicates,

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[1] D. Nachmansohn, *Bull. Soc. Chim. biol.*, 21: 761, 1939.

[2] D. Nachmansohn, *Yale Jour. Biol. and Med.*, 12: 565, 1940.

[3] R. Couteaux and D. Nachmansohn, *Proc. Soc. Exp. Biol. and Med.*, 43: 177, 1940.

[4] E. J. Boell, J. Needham and V. Rogers, *Proc. Roy. Soc.*, (B) 127: 322, 1939.

[5] Personal communication from F. O. Schmitt. See also figure in Bear, Schmitt and Young, *Proc. Roy. Soc.* (B) 123: 496, 1937.

because the enzyme may be localized in a small fraction of the remaining volume. The figures found for the activity of the total giant fiber are, as could be expected, intermediate between those for the sheath and those for the axoplasm.

The experiments bring evidence for the high concentration of the enzyme at or near the surface of the nerve cell. They suggest that the activity of nerve cells is connected everywhere at or near the surface with the metabolism of acetylcholine and that the phenomenon is only quantitatively more important at synapses. This would explain the findings of Lorente de Nó[6] that acetylcholine can be liberated from fibers as well as at synapses and is compatible with the conclusion of Gasser and Erlanger[7,8] that conduction of nerve impulses along fibers and across synapses differs only quantitatively.

We are greatly obliged to Dr. H. B. Steinbach for the dissection of the fibers.

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FELINE PELLAGRA[1]

In recent years, a large number of investigators have shown that nicotinic acid is essential for the health and well being of dogs,[2,3,4] pigs,[5] monkeys[6] and human beings,[7,8] but so far as we have ascertained no studies have been reported of its role in the nutrition of cats.

The present communication describes typical symptoms of nutritional deficiency in cats which are relieved dramatically following a daily oral dose of 80 to 100 milligrams of nicotinic acid.* Each of the six cats studied had lost weight and refused food. They appeared weak, sluggish, apathetic, and usually the head hung much lower than the rest of the body. They made no effort to move even when poked, and offered no resistance to hyperextension of the mouth and other physical manipulation. Examination of the oral cavity presented a peculiar yet typical appearance, characterized by an ulcerated, reddish margin in the upper part of the palate close to the midline, and a tongue that was very red over the terminal portion. Thick saliva of an extremely foul odor drooled from the mouth. Each animal had an elevation in temperature of around 3 to 5 degrees.

Within 48 hours following the administration of nicotinic acid, there was a return of appetite, subsidence of symptoms and disappearance of the oral lesions, and the temperature became normal.

The following representative case history describes the symptoms of feline pellagra and illustrates the dramatic response of an affected cat to nicotinic acid therapy.

A fourteen-month old male cat was brought to the veterinarian on August 10, 1940. For two days he had refused all food, had slept most of the time, and had remained in one place unless forced to move. His temperature was 105.8° F. The tongue was fiery red in color. The anterior border of the tongue showed an area about ¼ inch wide of ulceration and congestion. There was slight congestion and a few small ulcers in the throat. A small amount of thick saliva drooled from the mouth.

This animal was given orally 80 milligrams of nicotinic acid for two days, at the end of which time the tongue began to clear, his throat became normal and the drooling ceased. He began moving around in the cage voluntarily. By the third day, the tongue had resumed its normal color, and the cat appeared normal in every way. He drank milk and was able to eat canned food. He was dismissed from the hospital at this time, and a daily oral dose of 30 milligrams of nicotinic acid was prescribed for the next four days.

Summary. The present communication describes a deficiency disease in cats which responds promptly and dramatically to the administration of nicotinic acid.

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J. W. MacQueen
T. D. Spies

STRUCTURE-PROTEINS

It is generally believed that fibrous protein molecules are found only in tissues having a mechanical function, like hair (keratin), muscle (myosin), tendon (elastin). Most of the other proteins studied have been found to be globular.

The globular shape entails a certain mobility; the rod-shape an ability to form solid structures. Accordingly, we think that wherever nature needs a mobile protein (serum albumin and globulin, secretions like milk-proteins, hormones like insulin, different enzymes, etc.) it applies the globular shape, and wherever it wants to build a solid structure it applies the rod shape. Proteins have been found to be mostly globular because unconsciously the mobile and more easily accessible proteins have been selected for study. The fibrous nature of proteins, having a mechanical function, has been recognized not because these are the only fibrous proteins, but because the mechanical function conditions a coaxial arrangement of the molecules, which arrangement makes the rod shape easily detectable.

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[6] R. Lorente de Nó, Science, 91: 501, 1940.

[7] H. S. Gasser, *Jour. Neurophysiol.*, 2: 361, 1939.

[8] J. Erlanger, *Jour. Neurophysiol.*, 2: 370, 1939.

[9] This work was made possible by a grant of the Dazian Foundation.

[1] From the Department of Internal Medicine, University of Cincinnati, Cincinnati, Ohio; the Department of Medicine, University of Alabama, and the Hillman Hospital, Birmingham, Alabama: these studies were aided by a grant from Anheuser-Busch, Inc.

[2] H. R. Street and G. R. Cowgill, *Proc. Soc. Exper. Biol. and Med.*, 37: 547, 1937.

[3] C. A. Elvehjem, R. J. Madden, F. M. Strong and D. W. Woolley, *Jour. Biol. Chem.*, 123: 137, 1938.

[4] W. H. Sebrell, R. H. Onstott, H. F. Fraser and F. S. Daft, *Jour. Nutrition*, 16: 355, 1938.

[5] H. Chick, T. F. Macrae, A. J. P. Martin and C. J. Martin, *Biochem. Jour.*, 32: 10, 1938.

[6] L. J. Harris, *Biochem. Jour.*, 32: 1479, 1938.

[7] P. J. Fouts, O. M. Helmer, S. Lepkovsky and T. H. Jukes, *Proc. Soc. Exper. Biol. and Med.*, 37: 405, 1937.

[8] T. D. Spies, Clark Cooper and M. A. Blankenhorn, *Jour. Am. Med. Asn.*, 110: 622, 1938.

* Supplied through the courtesy of Merck and Company, Rahway, New Jersey.

If an animal tissue, like kidney, is extracted with weak saline, the mobile, globular proteins go into solution making about one third of the total protein. The remainder is insoluble in weak saline and represents the morphological structure, the solid edifice of the cell. This part of the protein is fibrous, as can be demonstrated by the intense double refraction of flow. In most tissues about half of this structure-protein can be brought into solution by extraction with Edsall's fluid (0,6 m KCl, 0,01 m Na_2CO_3, 0,04 $NaHCO_3$) containing 30 per cent. urea. The viscous, thixotropic protein can be precipitated by diluting (1:5) and neutralizing the solution. The protein, extracted in this way, seems to form a definite fraction analogous to myosin. The protein also contains P in quantities comparable to the P of vegetable viruses. The rod shape and P content of these proteins invalidates two of the arguments brought forward for the oxogenous nature of certain viruses. Chloroplasts also contain fibrous proteins. The remainder of the protein, representing about one third of the original, can be brought into solution by treatment with 2 per cent. NaOH containing 30 per cent. urea at 60°. This fraction also shows a marked double refraction of flow.

By squirting the urea-salt solution into water the proteins can be pulled into threads, which, after drying, can be studied röntgenoscopically. The first measurements indicate that they are built on the same pattern as myosin or keratin.

Globular proteins, if treated with urea-salt or urea-NaOH give no double refraction of flow (serum albumin and globulin, casein, ovalbumin, lactalbumin, gelatin, edestin).

This research was sponsored by the *Josiah Macy Jr. Foundation,* New York. Detailed report will appear elsewhere (*Enzymologia*).

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

DOUBLE-STAINING IN TOTO WITH HEMATOXYLIN AND EOSIN

A METHOD of double-staining *in toto* with hematoxylin and eosin has been devised primarily for vertebrate embryos, but has also been applied to various vertebrate and invertebrate tissues with equal success. It is simple, reliable and a great time-saver when large numbers of sections, especially serial sections, are required. Furthermore, it eliminates the danger of losing any of the sections, which might easily occur if these were stained on the slide.

By using a modification of Ehrlich's hematoxylin as a toto-stain I have obtained excellent results with both embryological and histological materials of sizes up to 1 cm in diameter. The formula is as follows:

Ehrlich's hematoxylin, stock solution	8 cc
50 per cent. alcohol	30 cc
Glacial acetic acid	2 cc

This staining solution is highly penetrating, does not overstain and gives a practically pure nuclear stain if it is followed by a proper washing with very weak acetic acid. The entire procedure involved in this double-staining method is outlined below:

(1) Fix embryos or pieces of tissue in Bouin's fluid for 1 to 3 days, according to size. Wash and preserve in 70 per cent. alcohol.

(2) The yellow color in the tissue is removed by soaking in several changes of 70 per cent. alcohol saturated with $NaHCO_3$ or $KHCO_3$ (allowing about one hour for each millimeter of tissue). Then wash out the bicarbonate in 50 per cent. alcohol for one or more hours.

(3) Stain in 20 vols. of modified Ehrlich's hematoxylin for 2 to 5 days (about one day for 2 mm of tissue). Shake from time to time to insure uniform penetration of stain from all sides of tissue.

(4) After rinsing in water, soak tissue in several changes of 30 per cent. alcohol containing 0.5 per cent. acetic acid to extract the excess stain (about one hour for each millimeter of tissue). The last change of acetic alcohol should remain practically colorless after the tissue has been in it for half an hour.

(5) Slow running tap water overnight.

(6) Dehydrate through alcohols of 30, 50, 70, 85 and 95 per cent., 6 to 24 hours in each grade.

(7) 95 per cent. alcohol with 0.3 per cent. eosin (alcohol-soluble), 12 to 24 hours.

(8) Absolute alcohol with 0.3 per cent. eosin, 12 to 24 hours.

(9a) For small embryos and soft tissues, clear in chloroform by the sinking method as follows:

In a small dish or a wide shell vial, pour a layer of chloroform on the bottom and then a layer of absolute alcohol with eosin on top of it. Next, place the embryos or pieces of tissue in the alcohol and allow them to sink slowly into the chloroform; leave for 2 to 6 hours or until they have sunk to the bottom.

(9b) For large embryos and for tissues which become tough or brittle easily, clear in synthetic oil of wintergreen by the sinking method. Then replace the oil with chloroform in similar manner.

(10) Chloroform saturated with paraffin overnight.

(11) Melted paraffin, 2 or 3 baths, 1 to 3 hours in each bath. Embed in the usual way.

(12) Cut sections, attach them to slides by the albumen-water method, and dry for 24 hours or longer.

(13) Put sections in xylol to remove paraffin; bring them to absolute alcohol to differentiate the eosin, then back to xylol; mount in balsam.

Sections made from materials thus prepared are stained sharply and uniformly from center to periphery, and show good color differentiation similar to those stained on the slide. Among the tissues tried were pieces of Nereis, clam gill, grasshopper testis, Amphioxus, salamander liver and stomach, mammalian skin, pancreas, cartilage and growing bone, a 10 mm pig embryo and portions of a young shark having a diameter of 14 mm. Equally good results were obtained for all of them. In the grasshopper testis, the metaphase chromosomes and the spindle structure were nicely brought out but, as with the other alum-hematoxylins, except iron hematoxylin, the centrosomes were only faintly stained.

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Peking, China

STERILIZATION OF SURGICAL INSTRUMENTS BY DI-ETHYLENE GLYCOL

Sterilization of surgical instruments by boiling water involves disadvantages: the boiling point of water is relatively low; mineral deposits or stains may occur, especially if the water is hard; and there is a tendency for boiling water to dull the edges of cutting tools. Di-ethylene glycol is relatively free from these objections. While it may fume on heating, this is negligible when small sterilizers are used. If an electric sterilizer is set at "low," the temperature of the liquid rises to about 150° C. As its boiling point of 250° C. is approached, it fumes more markedly, but adequate sterilization should be obtained at temperatures where fuming is not apparent. On standing it evaporates very slowly so that only small amounts at infrequent intervals need be added to the sterilizer to keep it full. Di-ethylene glycol leaves neither stains nor deposits on the instruments. It has no appreciable dulling effect on cutting edges. Since it is completely soluble in water, di-ethylene glycol residues may be promptly removed by dipping the heat-treated instruments in sterile water before use. Finally di-ethylene glycol is relatively inexpensive and readily available from chemical supply houses. These observations are based on two years' exhaustive trial with the compound in comparison with many others recommended for sterilization of dental instruments.

Charles Gurchot
Newton D. Mellars

University of California
San Francisco

"STUCK" SYRINGES

A simple and effective method of separating a "stuck" syringe is to place it in a container of concentrated nitric acid completely covering the syringe. Leave it immersed for a variable length of time, a week or two usually being sufficient.

W. J. Nungester

University of Michigan

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MINERAL NUTRIENTS IN RELATION TO FLOWER DEVELOPMENT[1]

By Professor W. F. LOEHWING

THE STATE UNIVERSITY OF IOWA

FOR several years, the writer and his associates have [redacted] ment, appeared to offer exceptional promise of valuable results, not only as to the functions of mineral nutrients in flowering but also as to their specific role in general developmental physiology.

Though interest in these investigations has centered primarily in the physiology of flowering, physiological studies obviously could not be confined to this phase alone. Only a continuous and detailed chronological [redacted] he progress of events in root and shoot, ative, flowering and fruiting phase pro- isite interpretative data. Because the t changes of the flowering phase are d (Borthwick and Parker, 1939) the lyses of entire tops have to be supple- separate, sequential physico-chemical rmatively active zones of growth. For interpretative purposes, these data must be expressed in absolute amounts of the individual constituents as well as in the traditional terms of percentage composition. Determination of salts by actual weight is essential because of the fact that the relatively greater rate of carbohydrate and protein accumulation in plants tends to mask the critical changes in actual amounts of mineral matter. A progressively diminishing percentage of salt constituents may, for example, represent an actual gain in total amounts thereof. The divergence between percentage and absolute weight of salts is, in fact, the usual case in the growing plant. Salt content actually rises in the vegetative plant but appears in the data as a progressively lower percentage of the entire dry weight. During the reproductive phase, on the other hand, diminishing percentages of salts may frequently reflect reduction in total amounts, as becomes apparent from data discussed herein. Omission of such actual weights from many otherwise thorough studies in the literature of mineral nutrition has greatly diminished their interpretative value.

---

[1] Address of the retiring president of the American Society of Plant Physiologists, Columbus, Ohio, December 28, 1939.

With reference to the analysis of small amounts of tissue, it may be pointed out that earlier handicaps in this connection have, in considerable measure, been removed by recent perfection of micro-analytical and histo-chemical procedures. These micro-methods not only permit analysis of the minute amounts of meristematic and floral tissues available to the physiologist but also greatly expedite analysis generally. Micro-analyses of localized areas facilitate correlation of such data with histological sections prepared from the same tissues. As a final technical detail, pot cultures of known weight in coarse sand or silica gravel permit a continuous check on growth and transpiration, and also facilitate recovery of the root system.

During the course of the experiments in a controlled greenhouse environment, certain major trends soon become evident in hemp, beans and other herbaceous annuals studied. Rapid intake of potassium and phosphorus characterizes the period of seedling growth, but are overtaken by nitrogen absorption prior to initiation of floral primordia (Demidenko and Popov, 1937). Under conditions of adequate nutrient supply, the first obvious indication of flower inception is a rather abrupt and progressive increase in the rate of transpiration, readily detectable by the amount of water necessary to maintain the cultures at approximately constant weight. Despite the transitory rise in rate of absorption, tissue analyses at this stage show that plants actually undergo a change in water balance in the direction of lower water content and higher percentage dry weight. Water loss definitely exceeds rate of supply and a trend toward progressive dryness of tops is initiated (Bakhuyzen, 1937; Gouwentak, 1929; Mothes, 1931; Smirnov, 1928). The trend toward tissue dehydration, once started, is ordinarily continuous for several weeks and sometimes even to ultimate maturity. It is interesting to note that this increase in transpiration and change in water balance frequently precedes the appearance of visible floral structures.

Reduction in water supply entails a proportional change in solute concentration of all tissue fluids (Bakhuysen, 1937). A rise in osmotic pressure of press sap is readily demonstrable but owes its origin not only to increased concentration of mineral nutrients but also to a rather sharp rise of soluble nitrogen and carbohydrates in the sap. The change in water balance thus appears to induce hydrolysis of insoluble protein and polysaccharide reserves, a metabolic transition generally known to presage early structural modification. Rise in rate of transpiration and the subsequent hydrolysis of insoluble carbohydrates originates in restricted areas of which the shoot apices are the initial foci. Increase in tissue dry weight spreads from these apical regions to adjacent leaves. Rapidly transpiring leaves thus deplete the water supply of contiguous tissues of lower osmotic pressure. Normal translocation upward is deflected from apical zones, and salts commence to accumulate in axillary loci. Dehydration is progressive in leaves and stem until entire shoots are involved.

In the roots, the change is not immediately one of altered water balance but rather a reduction in rate of salt intake, as becomes evident from successive determinations of the total mineral matter (Potapov, 1938). The percentage drop in salt content usually noted in roots at this stage is not wholly ascribable to the rapid increase of organic materials but represents in part an actual diminution in rate of salt entry. Determinations of actual salt content rather than its percentages are extremely helpful in the immediate detection of this change in root activity. Eventually, as flowering approaches its ascendency, the water content of the root system also becomes depleted and it then parallels the progressive drying of the shoots. The root at this time lapses into a state of retarded absorption of both salts and water which tends to accentuate tissue dehydration generally throughout the plant. Other investigators have also previously observed that salt intake up to the time of flowering is approximately commensurate with rate of supply but that it then begins to fall off (Crowthers, 1934; Deleano, 1936).

As the fall in water content of roots and flowering tops becomes more pronounced, there occurs a marked redistribution of salts throughout the entire plant. Entire shoots commence to lose an appreciable proportion of their nutrient reserves (Burd, 1919; Deleano, 1936) while at the same time residual salts tend to accumulate at floral loci. Nutrient depletion of vegetative organs and later even of accessory floral parts leads to an ultimate concentration of salts in developing stamens and pistils (Combes, 1938). Relative proportions of the different ions in the stem as a whole are also materially altered. Nitrogen and phosphorus accumulate at reproductive centers in part at the expense of shoot apices.

It is interesting to note that the number of floral primordia initiated is usually correlated with the amount of nitrogen and phosphorus in adjacent tissues (Biddulph, 1935; Cameron and Appleman, 1934; Grainger, 1938; Haas, 1935; Polster, 1938). Localized nutrient reserves thus appear especially important in early phases of flower development. In short, at the time of flowering all the nutrients, organic and inorganic, are in a state of extreme flux, which appears to be a mobilization of food reserves preparatory to the later utilization of certain compounds at reproductive centers. Similar responses with reference to concentration of organic reserves in developing fruits have been reported by other investigators (Murneek, 1932–37; Kraus and Kraybill, 1918) but actual mobilization seems to commence well in advance of fruiting proper (Bakhuyzen, 1937).

To judge from the universality and profundity of other changes which promptly follow, the original shift in internal water balance is by far the most significant event in the entire nutritional picture. Uniformity and magnitude of the drop in water content make it a reliable index to the onset of flowering. Shift in water balance, indeed, appears to resemble a trigger action which unleashes extensive subsequent changes in metabolism of roots as well as shoots.

The increase in osmotic pressure of tissue fluids in the tops gradually extends to the roots and is attributable in part to the translocation there of salts from the tops as reproduction progresses. Though there is a rise in *percentage* of salts in the root and a rise of salt concentration in root sap, the *absolute amount* of inorganic ions is usually less on a true weight basis. These facts lead, then, to the obvious conclusion that the salt content of the entire plant is often less during the reproductive than during the previous vegetative stage. This implies excretion of nutrients from root to soil (Ackromeiko, 1932–36; Bakhuyzen, 1937; Burd, 1919; Loehwing, 1937; E. C. Miller, 1939). The phenomenon of nutrient excretion is especially evident in plants grown at high nutrient levels (Luttkus and Boetticher, 1939). But even in plants under conditions of inadequate feeding there is also evidence of similar accumulation of salts in the roots at the expense of tops. The element particularly involved in excretion is potassium with lesser amounts of nitrogen and phosphorus (Deleano, 1936; Ackromeiko, 1936). The speed and apparent ease with which potassium moves from tops of high to roots of lower osmotic pressure during the period of disturbed water balance, suggests a poising function of potassium in avoidance of injurious extremes of both osmotic pressure and nutrient disbalance among the mineral salts in the aggregate.

The metabolic readjustment to this increase in solute concentration of tissue fluids is extremely far-reaching. For example, plants at this stage are very conspicuously sensitive to drought, a fact noted by other workers in a wide variety of plants (Saskin, 1938; Bakhuyzen, 1937; Stevanovskii, 1936; Maximov, 1929). Drought sensitivity during flowering is presumably interpretable as a definite increase in foliar permeability. If behavior of this sort is demonstrable in experimental plants under conditions of uniform water supply, the effects of water disbalance at the flowering stage must be even more pronounced in crops under the natural field conditions of water scarcity during midsummer. The entire literature on mineral nutrition is replete with evidence of water shortage during the flowering phase of crop plants, and it is difficult indeed to understand that its physiological significance has not been generally recognized.

The functional as apart from the formative aspects of flowering, then, seem to involve the following sequence of events, namely, increased transpiration and its resultant upset of internal water balance in the shoot; osmotic and solute increments of the sap; and finally redistribution of nutrient elements throughout the entire plant, often involving some elimination of salts from the root.

With reference to mineral nutrients, the net effect of these changes during flowering would be to make the shoot, temporarily at least, largely dependent upon its own residual supply of salts rather than upon any rapid upward flow thereof from the roots (Crowthers, 1934). The assumption of what amounts to a partial, functional separation of root and shoot derives support not only from the above described changes in nutrient distribution and drought sensitivity but also from the vascular alterations known to be associated with flowering. The important researches of Roberts (1939) and associates (Struckmeyer, 1938; Wilton, 1936) on reduction in cambial activity and the resultant restriction in phloem clearly indicate that the flowering plant confronts serious problems in translocation (Gill, 1933; Liehr, 1927; Whyte, 1929). Wisconsin investigators (Roberts, 1939) report that locally applied low temperatures in the form of a girdle about the stem also act as an effective means of flower production, an observation which adduces additional evidence that reproduction is correlated with modified translocation. Similar reproductive responses have been induced by general low temperature treatment (Thompson, 1936–38) and by constrictions about stems (Roberts, 1939). Further corroboration of the conclusion that impaired conduction disposes to flowering is found in the recent painstaking work of Borman (1939) on the rooting of flowering cuttings. He finds, for instance, that cuttings of *Mirabilis viridis* taken in full bloom continue to flower until they take root, after which they initiate vegetative growth. Some of Borman's other data on rooting of cuttings also suggest a connection between flowering and restricted transport of nutrients.

Any stimulus which renews vascular development, rapid absorption and mass flow of nutrients re-initiates vegetative growth. This is shown in experiments on rejuvenation by reversal of the photoperiod. Plants in blossom can usually be induced to renew growth by shifting to a vegetative photoperiod. Within two days after such alteration in the light period, there occurs a drop in transpiration, followed by increased intake of water and vegetative proliferation at stem apices.

Mobilization of organic and inorganic feed reserves in the manner described has previously been associated by other investigators (Murneek, 1925–37) with the process of fruit development. In the speaker's opinion, there is no actual discrepancy in the two points of view, nor is there any doubt about the intense food demands of enlarging fruits in heavily fruited species. Our own data merely indicate that mobilization of reserves *begins* with flower formation rather than with fruiting. This is apparently preparation for the immediate and large respiratory demands of flowering itself as well as for the heavier nutrient demands of fruit enlargement. High rates of respiration during the flowering phase temporarily deplete carbohydrate reserves, yet this very fact makes the concentration of salts at floral loci especially noticeable. On the experimental side, it is easy to miss nutrient changes which originate during flower inception because this phase is brief and soon overshadowed by events of the fruiting phase.

It is interesting to observe that as fruiting attains ascendency, there again occurs a gradual rise in rate of water absorption and the entire picture of water relations is one of better balance. Transpiration gradually subsides with onset of fruiting but ordinarily does not fall to the vegetative level. Simultaneous with the improved water balance of the fruiting phase, the flow of inorganic nutrients from root to top is accelerated. From the nutrient standpoint, conditions in the fruiting plant somewhat resemble those of the original vegetative phase except that fruits instead of vegetative structures now serve as centers of deposition. Fruit development may, in fact, be the actual inception of vegetative nutrition by the young embryos which merely employ the old sporophyte instead of the soil as a substrate.

There still remains, of course, the problem of nutrients in relation to sexual differentiation; namely, as to the factors responsible for differentiation of pistils and stamens. In this connection mineral nutrients are probably less specific in their influence than certain morphogenic inductors, like the so-called flowering hormones (Cailachian, 1937; Kiesel and Pachewitsch, 1938; Riede, 1937; Savelli, 1937) which may be a carotinoid (Murneck, 1934). But certain inorganic ions are not without effect even in this connection, as evidenced from our data on sex differentiation in dioecious forms. High nitrogen supply results in a pure stand of pistillate hemp plants, while low nitrogen produces entirely staminate plants (Tibeau, 1936). The results are not attributable to selective mortality.

Physiological studies on sex expression in hermaphroditic species are more difficult than in dioecious forms because of the close proximity of the two sex organs. This complicates disentanglement of the staminate and pistillate processes which precede the actual appearance of the sex parts themselves. Combes (1936) has recently shown that accessory floral parts supply mineral nutrients first to the developing stamen and later to the pistil (Mason and Phillis, 1936). High nitrogen content is in general associated with pistil differentiation in both dioecious and monoecious species (Howlett, 1936; Loehwing, 1933; Tibeau, 1936) while low soluble ash favors stamen inception (Stanfield, 1937).

In summary, the sequence of physiological events antecedent to and concurrent with flowering comprises, first, the change in internal water balance, followed in turn by altered translocation and redistribution of nutrients. Precise knowledge of the pattern of salt distribution aids in identification of phosphorus and nitrogen as the inorganic ions most closely associated with early phases of the transition from the vegetative to the reproductive phase. Amino compounds seem to be especially specific in their effects on sex processes, and studies are now under way to identify them and determine the precise role of commonly occurring amino acids.

PETROLEUM AND NATIONAL DEFENSE[1]

By Dr. GUSTAV EGLOFF

DIRECTOR OF RESEARCH, UNIVERSAL OIL PRODUCTS COMPANY, CHICAGO, ILLINOIS

THE United States has the largest and most efficient army of fully trained petroleum hydrocarbons of any nation in the world or any combination of nations, available for immediate service to meet any need, either peacetime or in the national defense.

With 61 per cent. of the world's total oil production occurring within this country, American technology has developed the world's most effective and, in many instances, only methods for maneuvering this army of petroleum hydrocarbons into the patterns which result in motor fuels and other products of a quality to more than meet the exacting requirements of high-powered engines of the most advanced design. It has applied these methods for designing petroleum molecules for quality fuels in peacetime on a scale which is not remotely approached by all other nations combined.

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[1] Address delivered at Purdue University, October 31, 1940.

The United States has almost all the world's production of 100 and higher octane aviation gasoline, which supplies enormous increases in maneuverability, cruising range, lifting power and speed to airplanes with engines designed to utilize the properties of this fuel. Such production of 100 octane gasoline as there is outside the United States is by American processes, and is almost entirely concentrated within the British Empire.

The Americas control over 1.5 billion barrels out of the 2 billion yearly crude oil production—over three times as much as the rest of the world. The United States alone produces over one and one-half times as much or sixty-one per cent. of the world's total. The oil industry of the United States is ready now to produce any volume of oil for any purpose required—whether for peace or national defense. There will be no need for the gasolineless Sundays that occurred during World War No. 1. Crude oil production and refining facilities can be stepped up rapidly whenever the demand is present. Within its own borders the United States has more than enough natural gas and crude oil to produce all the aviation gasoline, motor fuels and lubricating oils for our every need. That strategic material, rubber, can be produced by the oil industry in any quantities required; this also holds true for the explosive, TNT.

Present indications are that the Axis powers might develop a real shortage of oil and lubricants for industrial, air, army and navy requirements in event of a long war. This shortage will be based upon lack of crude oil and substitute fuels, whether from hydrogenation of coal, carbon monoxide, liquefied hydrocarbon gases and gas produced from wood, coal, lignite and coke, directly on the motor vehicle. The volume of oil produced within European countries has not been sufficient to cover the amounts consumed even in peacetime.

Germany's crude oil and substitute fuels show an estimated yearly production of 49 million barrels. This represents less than two and one-half per cent. of the world's crude oil. Oil consumption in Germany and Czecho-Slovakia in 1938 amounted to 60 million barrels, a figure which in spite of curtailment of all civilian uses of petroleum can not cover the military requirements on a 1940 wartime basis. Although large volumes of stored petroleum went to the German army by the capture of a number of countries, it is difficult to estimate the amount actually falling into their hands. This is due to the unknown factor of sabotage of oil supplies by retreating armies. Air raid destruction and damage of synthetic oil plants and storage now going on has cut fuel supplies.

Italy's oil from Albania and synthetic fuels is about two million barrels a year or less than one tenth of one per cent. of the world's crude oil.

The total oil production of Austria, Hungary, Poland, France, Rumania and Czecho-Slovakia amounts to 58 million barrels or about three per cent. of the world's total.

Crude oil production in Russia is about 220 million barrels or ten per cent. of the world's total, which is probably lower than her internal demands due to industrial, army and aviation expansion.

Japan's oil production is about one tenth of one per cent. of the world's total, whereas the Dutch East Indies yields about three and one-half per cent.

England's empire has oil sources of over 150 million barrels a year from Iran, Iraq, Bahrein, Burma, Trinidad and Canada, and may draw from the 205 million of Venezuela, 39 million of Mexico and 22 million of Colombia.

Accessible to Great Britain as long as her maritime power endures are the oil fields of Central and South America, which have a yearly production of 300 million barrels or fifteen per cent. of the world's total.

The United States has an inexhaustible potential supply of natural gas, crude petroleum, coal and oil shale for the manufacture of any conceivable quantity of oil products for national defense or peacetime requirement.

No other country produces the quantities or qualities of such petroleum products as motor fuels for airplanes, pleasure cars, motor buses, tanks and tractors. Aviation gasolines of 100 and higher octane rating, solely a product of research in the United States, that give airplane maneuverability, speed of climb, shortness of take-off and dead weight lifting power are also available from this source.

Superb lubricating oils are produced for every human requirement, whether it be for lubricating fine watches or spindles, heavy duty machines or 2,000 horsepower airplane engines, four of which power the latest flying fortresses. These newer lubricants developed in the United States are not only selectively refined, but contain added chemicals which impart high film strength and give greater oxidation and sludge resistance.

Diesel oils for low- to high-speed engines are produced to fit any need of tanks, buses, trains and submarines. With the development of 100 octane motor fuels, the gasoline engine has equalled the efficiency of the best Diesels of to-day with the added advantage of greater maneuverability in airplanes and other motor vehicles.

All battleships, cruisers, transports and airplane carriers use fuel oil and lubricating oil in huge quantities, but there are no demands, even if far in excess of present requirements made upon the oil industry, which can not be fulfilled.

Petroleum gases have also come into their own in the past few years, making possible such products of military importance as alkylates, isooctane and neohexane motor fuels, which are vitally necessary as fuels for airplanes.

Synthetic rubber from petroleum is manufactured from benzene and ethylene yielding styrene, and by dehydrogenation of butane forming butadiene. The synthetic rubber has about 30 per cent. greater wearing quality and strength than natural rubber in tires now on the market. There are over 200 billion pounds of synthetic rubber potentially available from petroleum yearly.

The lower boiling hydrocarbons in petroleum from Pennsylvania, Mid-Continent, Michigan, East Texas and Kettleman Hills, California, are mostly straight-chain paraffins. Upon catalytic treatment at 932° F. and at atmospheric pressure these hydrocarbons can be converted into benzene, toluene and the xylenes. These compounds are basic materials for such high explosives as picric acid, TNT and trinitroxylenes. The quantities potentially available from the petroleum industry are at the rate of 85 billion pounds yearly. Commercial units to produce toluene and TNT from petroleum are now being installed.

In either war or peace, the United States of America has within its boundaries more than enough crude oil for complete self-sufficiency and could, if necessary, supply the petroleum products for the world's needs.

SCIENTIFIC EVENTS

UNIVERSITY COLLEGE, LONDON[1]

. . . HERE I regret to have to tell you that the college suffered badly, first by a land-mine and then by fire. The land-mine carried away the Great Hall and did a great deal of damage to roofs, windows, etc., in the main buildings of the college (apart from Foster Court which was practically untouched). The medical sciences building lost practically all its windows and the big physiology laboratory at the top of the building has lost most of its roof. A few days later there was a fire (due to incendiary bombs) which destroyed the libraries north of the main library and Flaxman Gallery, including a good many of the arts libraries and a large part of the physical sciences library. All this has meant that any attempt to carry on the teaching of medical sciences in our own building during this session is impossible. I am glad to say, however, that we have been able to make arrangements whereby the students in the faculty of medical sciences will be working in a large building near Leatherhead, which had laboratories which could be adapted for the purposes of the faculty. The staff have been indefatigable in making these arrangements and I have every hope that the continuity of our medical teaching, possibly even of some of our medical research, may be secured. Arrangements are being made to put as much of the equipment as is possible in various places of comparative safety. With regard to the rest of the college, we are removing the remainder of the library to a place of comparative safety, and have managed to redistribute the students among various colleges and universities.

The main disasters happened two or three weeks ago, and I should have written to you long since, but it was only yesterday that the Ministry of Information released the facts. . . .

At the present time, one can do little more than carry on, but we look ahead to the time when this nightmare is over and we can start to build up our work again.

DAMAGE TO SCIENTIFIC INSTITUTIONS IN LONDON

INFORMATION has recently been received from London of the bombing of the British Museum (Natural History) at South Kensington. The museum has been hit by both high explosives and incendiary bombs. The most serious damage was caused by an incendiary bomb which fell on the roof of the east wing and penetrated to the foreign herbarium of the Botany Department. A large number of plant specimens were destroyed, and many thousands of herbarium sheets were badly damaged by fire and water. It is understood that the department of entomology was also damaged. American botanists are of the opinion that many unrecognized type specimens of American and other plants were stored in the Foreign Herbarium, though a great deal of the most valuable material from several departments of the museum had been removed from London last spring. The near-by Victoria and Albert Museum has also been hit. Neither building is close to any military objective.

The London *Times* writes as follows: "The library of the Royal Society of Medicine is the finest medical library in Europe. It contains 150,000 medical volumes and provides an information service to the fellows of the society wherever they may be. It has been giving valuable service to doctors in the fighting forces, oversea and at home, since the outbreak of war, and supplying information to men in the emergency medical services as well as in every department of medical life in this country. These services have been rendered in difficult circumstances, as the society lives almost entirely on the subscription income received from its fellows. This income has seriously diminished since the outbreak of war, but the society has nevertheless carried on with its important work. Officers returning from the beaches of Dunkirk have reported to the secretary that information received from the library was invaluable, and that they regretted having had to abandon books, bibliographies and photostatic reproductions in the face of the advancing enemy. The Rockefeller Foundation, learning of the society's service and of its plight, has generously given £1,000 to enable its headquarters at 1, Wimpole Street, to spread the target which it offers to bombing aeroplanes. With this gift it is being arranged to remove a large number of irreplaceable volumes to a suitable place in the country, where they will be easily available to inquirers for information."

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[1] Excerpt from letter of the 11th of October, 1940, to Dr. Alan Gregg, from Principal Allen Mawer, of the University College, London, England.

EMERGENCY COURSES TO TRAIN ENGINEERS AND TECHNICIANS

Emergency courses to train engineers and technicians needed in the nation's defense industries will be offered soon in a cooperative program sponsored by Harvard University, the Massachusetts Institute of Technology, Northeastern University and Tufts College.

The proposed program comprises full-time day courses, as well as evening courses of college grade for men who are employed. Organized to comply with the engineering defense training program of the United States Office of Education, this plan, which has been presented for formal approval, is part of a project supported by the government for specialized training in fields essential to national defense. The courses will be offered if there is sufficient demand to satisfy the requirements of the United States Commissioner of Education, and will be given without charge to the students for tuition.

The other engineering schools in the Northeastern regional district, which includes Maine, New Hampshire and Vermont, as well as Massachusetts, are preparing to offer similar intensive courses. These programs are being planned by the individual colleges, which have the cooperation of the regional adviser on engineering defense training, Dean Edward L. Moreland, of the Massachusetts Institute of Technology.

The joint program of the four greater Boston institutions was arranged to avoid duplication of courses and to assure the most effective utilization of the special teaching and laboratory resources of each. The committee in charge of the project, which is expected to train approximately 1,000 students, includes Dean Harald M. Westergaard, of the Harvard Graduate School of Engineering; Professor Raymond D. Douglass, of the Massachusetts Institute of Technology; Dean William C. White, of the College of Engineering of Northeastern University, and Dean Harry P. Burden, of the Tufts School of Engineering. None of the courses conflicts with or replaces regular evening courses now being offered by such agencies as the State University Extension Service, the Lincoln Institute, the Lowell Institute School or the university extension courses of Tufts College.

All courses in this program are of collegiate grade and in general the requirements for admission include at least three years in an accredited engineering school or its equivalent. In some instances two years in an evening engineering school plus practical experience may be considered sufficient preparation, and in certain cases other preparation may be acceptable. Certain highly specialized courses will require engineering degrees.

Application for detailed information on all courses to be given at the participating colleges in the Boston area should be made immediately, and by mail only, to the Engineering Defense Training Bureau, Room 7-102, Massachusetts Institute of Technology, Cambridge.

THE HOSPITAL OF THE MEDICAL COLLEGE OF VIRGINIA

Dedication of the new six hundred bed hospital at the Medical College of Virginia, Richmond, took place on December 5, Founders' Day. Among those participating were Governor James H. Price; Colonel E. W. Clark, Commissioner of Public Works, Public Works Administration; Dr. Walter L. Bierring, past president, American Medical Association; Dr. Walter B. Martin, president of the Medical Society of Virginia; Dr. H. E. Jordan, dean, department of medicine, University of Virginia; M. Haskins Coleman, Jr., secretary, Richmond Hospital Council, and Dr. Lewis E. Jarrett, director of the hospital division, Medical College of Virginia. Beginning at two o'clock in the afternoon the new hospital was opened for inspection to the general public, and on Tuesday night, December 3, a reception and hospital open house was observed at the hospital for the local medical profession and specially invited guests.

The new hospital, completed at a cost of approximately $2,500,000, with equipment, provides for two new services, neuropsychiatry and contagious diseases, enlarged facilities for physical therapy and many other activities, including ample provision for teaching. It is built in the form of a Maltese cross with the various utility services in the center of the cross, the wings themselves being used for the housing of patients. By this arrangement wards have exposure on both sides and each room has an outside exposure. It is completely air conditioned.

Acoustical treatment has been applied to all corridors, lobbies, utility rooms, diet kitchen and in any other place where excessive noise may be a disturbing factor.

The entire building is being wired for radio reception. A central unit will control reception and has a four-channel outlet to each part of the building. For the present, however, these channels are only being wired for two programs. The other two can be wired later at nominal cost. In the wards there are speakers attached to the ceiling, one speaker for each eight beds. Individual rooms will have individual speakers. The volume of the radio can be controlled at the central receiving station and each individual unit can be controlled in the wing itself.

THE MEETING OF MATHEMATICIANS AT BATON ROUGE

THE forty-seventh annual meeting of the American Mathematical Society will be held at the Louisiana State University, Baton Rouge, La., from December 30 to January 1, in conjunction with meetings of the Mathematical Association of America and the National Council of Teachers of Mathematics.

The sessions of the society will begin on Monday afternoon and will continue through Wednesday afternoon. The regular sessions of the Mathematical Association will be held on Thursday morning and afternoon. A joint session of the Mathematical Association and the National Council is scheduled for Wednesday morning. Other sessions of the National Council will be held on Monday and Tuesday.

The Board of Trustees will meet at 6 P.M. on Monday and the Council of the Society will meet at 8 P.M.

The annual business meeting and election of officers will be held on Tuesday evening. Following this, Professor G. C. Evans will deliver the retiring presidential address on "Surfaces of Minimum Capacity."

By invitation of the program committee, Professor Saunders MacLane and Dr. Leo Zippin will deliver addresses. Professor MacLane's title is "Extensions of Groups" and Dr. Zippin's, "Topology of Rigid Motions."

An excursion to St. Francisville and its environs to visit some of the old colonial residences is planned for Tuesday afternoon. Other alternative excursions may be planned later.

A joint dinner of the three mathematical organizations is planned for Wednesday evening.

AWARD OF THE MEDALS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

DR. CHARLES F. KETTERING, vice-president and director of General Motors Corporation and general director of General Motors Research Laboratories, received the American Society of Mechanical Engineers Medal, presented annually for distinguished service in engineering and science, on December 4. The presentation was made by Warren H. McBryde, national president of the society, at the annual dinner and honors night.

The award has been made to Dr. Kettering in recognition of his outstanding achievements as engineer, inventor and manufacturer. He invented and perfected the automobile self-starter and the Delco lighting system for farms and as a portable source of power. He is also largely responsible for many engine improvements and, most recently, for the development of improved Diesel engines for trains and ships. Dr. Kettering is patentee or co-patentee of about 140 inventions.

Edwin H. Armstrong, professor of electrical engineering at Columbia University and pioneer in the field of "frequency modulation" and other radio circuits, received the Holley Medal.

Dr. Armstrong has long been a leader in the development of radio communication. He was first to make practical use of the three-electrode tube for generating continuous electric waves which make radio broadcasting feasible; and invented the widely used superheterodyne receiving circuit. His most recent work has been in the new field of his own invention, FM or "frequency modulation" radio broadcasting, which has made practicable the avoiding of static nuisances, as well as decreasing danger due to lightning.

The Holley Medal is presented periodically for distinguished service in engineering and science. It is named for the late Alexander Lyman Holley, chairman of the meeting on February 16, 1880, at which preliminary plans for the organization of the society were discussed. It was endowed by George I. Rockwood, who recently retired as president of the Rockwood Sprinkler Company of Massachusetts.

The Melville Medal for original engineering work was presented to Carl A. W. Brandt, chief engineer of the Superheater Company, New York, for his paper on "The Locomotive Boiler."

Mr. Brandt was born in Stockholm in 1881, studied mechanical engineering at the Technical College there, and obtained his early engineering experience with the Swedish Government Railways and the Sweden Atlas Locomotive Works. He was with the New York Central Lines from 1902 to 1916, becoming mechanical engineer and master mechanic of the Cleveland, Cincinnati, Chicago and St. Louis Railway in 1910. He joined the Superheater Company as chief engineer in 1916, where he is now in charge of the development and design of locomotive equipment, including superheaters and feedwater heaters, in addition to similar apparatus for stationary power plants.

SCIENTIFIC NOTES AND NEWS

The William du Bois Duddell Memorial Medal of the London Physical Society has been awarded to Dr. Ernest O. Lawrence, professor of physics at the University of California at Berkeley and director of the Radiation Laboratory. It is expected that the presentation will be made on December 27 by Lord Lothian, British ambassador to the United States, at the meeting of the American Physical Society, which will be held at Philadelphia in conjunction with the American Association for the Advancement of Science.

At a special convocation on November 24, Columbia University conferred four honorary degrees. These included the doctorate of science conferred on Dr. Karl T. Compton, president of the Massachusetts Institute of Technology. The degree was to have been presented to Dr. Compton at commencement last June, but he was unable to be in New York at that time.

Dr. Torald Sollman, dean of the School of Medicine of Western Reserve University, and Dr. J. M. T. Finney, professor emeritus of surgery of the Johns Hopkins University, received the degree of merit of Nu Sigma Nu at a dinner given on November 23, which closed the annual convention in Detroit of the fraternity.

The Remington Medal, awarded annually by the New York branch of the American Pharmaceutical Association for constructive work in the interest of American pharmacy, was presented to Dr. Robert L. Swain, editor of *Drug Topics* and *Drug Trade News*, at a testimonial dinner given at the Hotel Pennsylvania, New York, on November 28.

The Gedge Prize of the University of Cambridge has been divided equally between Dr. D. A. Webb and D. K. Hill, both of Trinity College, for research in physiology.

Nominations for officers of the American Electrochemical Society include: for president, Raymond R. Ridgway, research engineer with the Norton Company of Chippewa, Canada; Frank E. Lathe, technical assistant to the president of the National Research Council of Canada, and A. F. Grant Cadenhead, director of plant research with Shawinigan Chemicals, Ltd.; for vice-presidents, Albert E. R. Westman, director of chemical research at the Ontario Research Foundation; Sherlock Swann, Jr., professor of chemistry at the University of Illinois; John W. Marden, assistant director of research of the Westinghouse Lamp Division, Bloomfield, N. J.; Malcolm Dole, professor of physical chemistry at Northwestern University, and Frank W. Brooke, consulting engineer.

Dr. Henry E. Meleney, associate professor of preventive medicine and public health at Vanderbilt University, has been appointed Hermann M. Biggs professor of preventive medicine and director of the laboratories of the New York University Medical School. He succeeds the late Dr. William H. Park.

Dr. Elmo N. Stevenson, of the Eastern Oregon College of Education at La Grande, has been appointed professor of science education at Oregon State College, Corvallis.

Dr. Jacob Levitt, formerly research fellow of the Royal Society of Canada, working at the University of Minnesota, and sessional lecturer in botany at McGill University, has been appointed junior plant physiologist in the Division of Plant Pathology and Botany at University Farm, St. Paul.

At the Texas Agricultural Experiment Station C. H. McDowell, joint superintendent for the station and the Soil Conservation Service of the Blackland Substation of the U. S. Department of Agriculture, became on September 1 vice-director and agronomist of the station. He took the place of Dr. Paul C. Mangelsdorf, who resigned recently to become professor of economic botany and assistant director of the Botanical Museum of Harvard University. H. O. Hill, project supervisor of the Soil Conservation Service at the Blackland Substation, has been appointed joint superintendent.

In the issue of Science for November 22, Dr. James Franck was referred to as professor of physics at the Johns Hopkins University. Dr. Franck came from the University of Göttingen to the Johns Hopkins University in 1934, but accepted a professorship of physical chemistry at the University of Chicago in 1938.

Dr. Robert Cushman Murphy, of the American Museum of Natural History, has been elected president of the Long Island Biological Association. He succeeds Arthur W. Page, who for twelve years has presided over the affairs of the Biological Laboratory at Cold Spring Harbor, Long Island.

Dr. Edward Bartow, emeritus professor of chemistry at the State University of Iowa, has joined the research laboratories of the Johns-Manville Corp., Manville, N. J. Dr. Bartow will act as research consultant in connection with chemical problems involved in all phases of the research activities of the company.

Colonel Sir Edward Thornton, secretary for public health and chief health officer of the Union of South Africa, has been appointed director-general of the Medical Defense Services of the Union of South Africa.

Dr. James A. Tobey, of New York, has been appointed chairman of the committee on food and nutrition in national defense of the Institute of Food Technologists. Dr. Tobey is director of the department of nutrition of the American Institute of Baking and is also lieutenant-colonel in the Sanitary Corps Reserve of the Medical Department of the Army. The Institute of Food Technologists was organized as a professional society in 1939, and now has more than 900 members throughout the United States.

Grants-in-aid for research have been received recently by the following members of the College of Medicine of the State University of Iowa: Dr. Harry M. Hines, of the department of physiology, $5,000, from the National Foundation for Infantile Paralysis for study of regeneration of nerve and muscle; Dr. W. D. Paul, of the department of internal medicine, $3,500, from the Emerson Drug Company for the study of the action of bromides, and Dr. P. C. Jeans, of the department of pediatrics, $3,000, from the Mead-Johnson Company for a continuation of studies on infant nutrition.

A grant of $7,800 a year for three years from the Commonwealth Fund of New York is to be used for the study of kidney disease by Dr. Joseph M. Hayman, Jr., professor of clinical medicine and therapeutics at the School of Medicine and the Frances Payne Bolton School of Nursing of Western Reserve University. A similar grant was made by this fund for the same purpose in December, 1937.

The Committee on Scientific Research of the American Medical Association has made a grant to Dr. David Polowe, who was recently appointed research fellow at Harlem Hospital, New York City, in support of his work on amylase activity in the blood.

Dr. P. H. Rolfs, emeritus life member of the American Association for the Advancement of Science, who for nearly twenty years has lived in Brazil, is returning to the United States and will reside at Gainesville, Fla. The Agricultural College was founded by the State of Minas Geraes under Dr. Rolfs's direction.

Dr. Victor K. LaMer, professor of chemistry at Columbia University, gave on November 15 at Yale University a lecture on "Kinetics and Equilibria of Exchange Processes in Deuterium Oxide," the third of the series of lectures on "The Applications of Stable and Radioactive Isotopes" sponsored by the department of physiological chemistry of the university.

Harold J. Coolidge, Jr., of the Museum of Comparative Zoology of Harvard University, spoke on December 1 before the Men's Faculty Club of Columbia University. His lecture was entitled "To Asia for Apes," and was illustrated with motion pictures and sound recordings made in the jungles of Siam, Borneo and Sumatra.

Dr. I. I. Rabi, professor of physics at Columbia University, lectured on December 4 at a joint meeting of the Franklin Institute, the Physics Club and the Physics Colloquium of Philadelphia. His lecture was entitled "Radio Frequency Spectra of Atoms."

The Pittsburgh Section of the American Chemical Society is sponsoring a popular public lecture on "Glass: To-day and To-morrow" by Dr. Alexander Silverman, head of the department of chemistry of the University of Pittsburgh, on the evening of December 11, in Carnegie Music Hall. The lecture will be illustrated with exhibits from the Glass Center in the New York World's Fair and from the Glass House in the Town of To-morrow.

Dr. Elmer O. Kraemer, biochemist in the research laboratories of the Franklin Institute, Philadelphia, delivered two lectures on December 3 under the auspices of the Foster Lecture Foundation of the University of Buffalo. The lectures were open to the public as well as to students. In the afternoon he spoke on "The Application of Centrifugal Methods in Colloid Research" and in the evening on "The Size and Shape of Large Molecules." Dr. Groves H. Cartledge, head of the department of chemistry and chairman of the Foster Lecture Committee, presided. The Foster Fund is endowed with the sum of $25,000 by Mrs. Orin D. Foster in memory of her husband.

The first lectures of the De Lamar Institute for 1940–1941 of the School of Hygiene and Public Health of the Johns Hopkins University were given on November 19 by Dr. Virgil Sydenstricker, of Emory University, Georgia, on "Dietary Problems of the Southern United States"; on November 26 by Dr. Otto A. Bessey, of the Harvard Medical School, on "Morphological Defects in Dietary Deficiency States," and on December 3 by Dr. George R. Cowgill, of the Yale School of Medicine, on "Nutritional Deficiencies in Tropical America." On February 18 Dr. Edward H. Hatton, of the Northwestern University Dental School, will speak on "The Etiology of Dental Caries," on March 4 Dr. Max Theiler, of the Rockefeller Foundation, on "Studies on Poliomyelitis," and on March 18 Dr. Charles N. Leach, of the National Health Division at Montgomery, Ala., on "Recent Studies in the Epidemiology of Rabies."

The Massachusetts Institute of Technology Chapter of the Society of the Sigma Xi has arranged for this year three lectures on "Man's Relation to his Environment." The subjects and the lecturers are: November 12, "Man's Relation to the Cosmos," by Dr. Cecilia Payne-Gaposchkin, Phillips astronomer at the

Harvard Observatory; January 14, "Man's Relation to the Earth," by Dr. Robert R. Shrock, assistant professor of geology at the Massachusetts Institute of Technology, and May 23, "Man's Relation to Other Men," by Dr. Kirtley F. Mather, professor of geology at Harvard University.

The fifth annual symposium of the Division of Physical and Inorganic Chemistry of the American Chemical Society will be held in Havemeyer Hall, Columbia University, on December 30 and 31 and January 1. The general subject will be "The Structure of Molecules and Aggregates of Molecules."

The Southern Section of the American Society for Horticultural Science will participate in the meetings of the Association of Southern Agricultural Workers to be held in Atlanta, Ga., from February 5 to 7. The program of the Southern Section will extend for a period of three days. On February 5 a conference will be held on the national sweet potato research program. On February 6 two symposia will be given, one entitled "Research with Tomatoes Grown in the South" and one other entitled "Research with Peaches." On February 7 a joint session will be held with the Soil Fertility Section of the American Society of Agronomy. Information may be obtained from Dr. J. B. Edmond, Clemson Agricultural College, South Carolina.

The program of scientific and technical departments at the Rochester Athenaeum and Mechanics Institute in Rochester, N. Y., will be expanded and strengthened as the result of an endowment campaign of approximately $750,000. George H. Clark, Rochester industrialist, who offered to contribute two thirds of a dollar for every dollar pledged by the public before December 31, 1940, has given approximately $300,000. He offered to give $400,000 if $600,000 were raised from other sources. Three-year, post-high school courses are given at the institute in the industrial chemistry, electrical, mechanical, photographic technology, construction, food administration, home economics, applied art, retailing and publishing and printing fields.

DISCUSSION

DENTAL RESEARCH AT THE NATIONAL BUREAU OF STANDARDS

The vital significance of the physical and chemical properties of dental restorative materials has, during the last twenty-one years, been amply demonstrated by a program of research at the National Bureau of Standards. The research was initiated by Souder and Peters in 1919, at the request of the War Department. The former, as chief of the bureau's dental reesarch laboratory, continues to supervise the research.

These men were able to show, through laboratory tests, defects in dental amalgam alloys, such as shrinkage and flow, in a large number of popular brands, which made it practically impossible for the dentists to place a filling which would give satisfactory service when these brands were used. As the research was extended to dental cements, gold alloys, denture resins and similar items, again many inferior trade brands were found indiscriminately assembled with and equally advertised with the superior brands.

The Weinstein Research Laboratories of New York City cooperated from 1922 to 1928 in the program of basic research. In 1928 the American Dental Association joined forces with the bureau. This was a most fortunate affiliation, as it permitted the extension of the research to include ample clinical tests by the association's members when and where desirable.

The first performance specification for a restorative dental material (dental amalgam alloy) was written by the National Bureau of Standards in 1925. With the assistance of the American Dental Association the number has been extended until there are now 12 such specifications. Each specification reflects the following influences:

1. Engineering principles involved in, and demands of typical dental restorations and appliances.
2. The suggestions and advice of representative members of the dental profession.
3. Information supplied by the manufacturers of dental materials.
4. A survey of the chemical and physical properties having a dental significance is conducted on each material.

The following items have been surveyed under the four-point program and are available to the dental profession, upon request, in specification quality: Amalgam, inlay casting investments, impression compound, inlay casting wax, inlay casting gold alloys, mercury, wrought gold wire alloys, zinc phosphate cements, silicate cements, denture rubber, hydrocolloidal impression materials and acrylic denture resin. These specifications are revised from time to time as new and improved materials are developed, thus enabling the dentist who demands specification quality always to be supplied with the highest quality materials available.

The Certification Plan

The following plan was adopted to protect more completely the dentist in the purchase and use of materials and to guarantee the practical effectiveness of the specifications.

1. Following the adoption of a specification by the

American Dental Association its Research Commission invites the manufacturer to forward a formal certificate guaranteeing compliance of his product with the specification.

2. The manufacturer must also demonstrate to the Research Commission that he has adequate testing facilities and personnel and that he makes routine tests of his guaranteed products or makes use of a laboratory that does have such facilities for such tests.

3. The Research Commission procures in the open market a representative retail sample of the material which the manufacturer has guaranteed.

4. The sample is tested at the National Bureau of Standards to see whether or not it meets the association's specification.

5. If the material is found to comply with the requirements (items 1 and 2 having been met) the trade brand name is then placed upon a List of Certified Dental Materials.

This list is published from time to time in the *Journal* of the American Dental Association. Forty-five thousand dentists in the United States regularly receive these lists and are able to assure their patients as to the quality of materials they are using. Progressive manufacturers of these dental materials have gladly cooperated with both the Bureau and the Association in making the plan effective.

Since the work was started, approximately 100 reports have been printed. These reports have unquestionably had a salutary effect upon the production and use of dental materials. As a specific example one needs only to cite the effect of the technical reports and the specification for zinc phosphate cements. These publications caused, within one year after their appearance, the modification of practically every cement of this type which was manufactured in the United States. Manufacturers took the necessary steps to make their cements more uniform, less soluble, stronger, finer grained and more nearly free of arsenic.

Thus it can be seen that the foregoing cooperative research and supervised certification policy have been very effective in promoting the use of highest quality materials and in stimulating the testing of and research on dental materials both in dental schools and in manufacturing establishments. The program has been found mutually useful to the manufacturer, to the dental profession and to the public. It is believed that similar programs would work equally well in other fields, as they furnish a direct approach between the responsible manufacturer and his customers and a maximum of protection to the public.

Geo. C. Paffenbarger,
Senior Research Associate of the American Dental Association at the National Bureau of Standards

CONTROL OF PRICKLY PEAR IN AUSTRALIA

In a recent publication[1] issued by the Imperial Bureau of Pastures and Forage Crops at Aberystwyth, Great Britain, among other matters there is an account of successful control of prickly pear in Australia through the introduction of insect enemies.

Various species of prickly pears (genus Opuntia of the Cactus Family) have been wide-spread weeds in Australia, where they were introduced from North and South America—*O. inermis* prior to 1839 and *O. stricta* about 1860. First planted for hedges and as a possible source of fodder these plants spread, until by 1925 over 60,000,000 acres were affected. About half of this area was occupied by a dense growth to a height of two to five feet, covering the ground to the exclusion of grass and herbage; the remaining 30,000,000 acres of infested land had great patches of prickly pear alternating with native vegetation.

The cost of eradication by chemicals or by mechanical means, digging or plowing, stacking and burning would have been about $50.00 per acre, while unaffected land adjacent was valued at only $2.00 to $5.00 per acre. Hence, year by year more land was abandoned, and holdings and homesteads deserted.

In 1920 the governments of the Commonwealth and of New South Wales and Queensland established the Prickly Pear Board to combat the infestation. Agents were sent to North and South America to study the diseases of prickly pears, but it was soon found that bacterial and fungous diseases offered little promise. Attention was then directed to insects attacking plants of the Cactus Family, and stations for study were established in many parts of the American continents; these stations were maintained either continuously or intermittently from 1920 to 1937. Insects which were discovered to feed upon prickly pears were fully studied, and when found not to attack plants of economic value were collected and shipped to Australia. There, in quarantine, they were tested again. About 150 species of insects restricted to cactus host plants were discovered, but only 15 were sufficiently promising to warrant their employment. They included the moth borer *Cactoblastis cactorum* from Argentine and Uruguay and other moth borers, besides species of cochineal insects, beetles, red-spider and two Coreid bugs. Following much experimentation there came the large-scale rearing of successfully acclimatized insects, their establishment in the field and later their mass distribution.

During the last ten years *Cactoblastis cactorum* has proved the chief agent for destruction of prickly pear; other insects introduced earlier were of some value, but they have all diminished in numbers or have even completely disappeared. Cactoblastis is distributed in the egg stage. The eggs are laid in chains, or "egg-sticks"; these can be handled and transported without injury, having first been glued to strips of paper or placed in wax-paper quills. Field workers, traveling roads and trails through prickly-pear land, pin the paper strips or quills to cactus plants. When the insects are once established in any locality no further distribution is necessary except to isolated and non-contiguous areas.

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[1] Herbage Publication Series, Bulletin 27, ''The Control of Weeds.''

Cactoblastis larvae devour the interior of the cactus branches, readily boring from one joint to another and even penetrating the roots; furthermore, their activities are accompanied by rotting due to bacteria and fungi. When only the above-ground parts of the cactus plant are destroyed by an onslaught of Cactoblastis a regrowth takes place from the roots, but this new growth is very succulent and is soon destroyed by a succeeding attack of the moth borer.

At the present time (1940) prickly pear infestation has been reduced from 75 to 95 per cent. of that in 1925. In the greater part of formerly infested areas the pest is under complete control; the scattered remaining plants are not a menace—indeed, they are of value for breeding of Cactoblastis. Areas of former dense prickly pear are now being used for crops, for dairying and for grazing. The great bulk of former prickly pear territory is now reclaimed; it will never revert to its previous useless state.

Francis Ramaley

University of Colorado

THE DENS AND BEHAVIOR OF THE DESERT TORTOISE

Studies of the desert tortoise, *Gopherus agassizii*, have shown a definite behavior pattern in which the individuals tend to congregate together in winter dens during cold weather, spread out over nearby areas during moderate weather, and descend into short individual burrows when it is too hot. The studies have been carried out on the Beaver Dam Slope in extreme southwestern Utah since 1936. The area selected was particularly favorable for the winter den concentrations, hence it is not certain at present whether this pattern is general over all its range.

More than 200 tortoises have been marked for individual identification by burning the letter U into different plates or combinations of plates on different individuals so that each one so marked could be definitely identified. During 33 visits to the area, tortoises have been recaptured from time to time, the number of recaptures of individuals ranging from 0 to 11 times. The total captures of tortoises reaches nearly 500 up to date.

The 68 winter dens we have studied are found mostly in compact gravel banks, and usually extend from 5 to 30 feet horizontally into the bank. In cross-section, they are somewhat oval; in length they may be straight, bent, forked or have enlarged chambers. The size does not generally permit entrance by man, but several have been excavated to permit investigation.

The dens are regularly occupied from November to February inclusive, although there undoubtedly is a slight amount of movement from den to den during these months. March and October appear to be the months of transition. During March, fewer and fewer, and during October, more and more are found in the dens. From April to September inclusive, the dens are deserted except for occasional stragglers.

During this period, the tortoises are scattered over the surrounding terrain, usually as solitary individuals, occasionally as copulating pairs. As long as the temperature is comfortable, they do not appear to bother about shelter. As the days get warmer, they tend to move into the shade of a bush, but when the days get hot and the ground vegetation parched, they resort to the summer holes.

These summer holes dip sharply downward 3 or 4 feet and are usually deep enough to protect the tortoises from the torrid heat of midday. They usually emerge at night when the temperatures are more propitious.

The territory covered by individual tortoises, indicated at least in part by plotting the points of capture on a map, is not large. Some individuals with at least 10 capture records do not cover an area of more than ten acres. Others wander farther afield, but the largest territory indicated up to date is only about 40 acres. These records, while not necessarily conclusive, at least indicate that the tortoises are closely restricted to a small territory.

A more detailed report of these studies will be published elsewhere at a later time.

A. M. Woodbury

University of Utah

Ross Hardy

Dixie Junior College

ELECTRIC FENCES THAT REPEL DEER

Protection of growing crops against deer by the use of electric fences has become an acute necessity in many parts of Texas. In agricultural areas which also contain suitable range for deer, the perennial question of balancing these conflicting interests has engaged alike the attention of landowner and sportsman, and with some success. For the past two years experimentation with several kinds of fences in central Texas has resulted in the selection of the most successful type. Improper installation and therefore failure of such fences to do any good has resulted in hasty and harmful conclusions. It was learned that a single electrified wire, without any supporting fence near, was adequate to stop cattle and horses, but not deer. The deer-repellent fence, which has proved successful at two places in Kerr County where deer are abundant, was installed by State Game Warden Bill Garrett as follows: On the outside of a ten-acre farm, five feet from the regular fence, a single No. 9 telephone wire was strung on insulators 20 inches above the ground and charged with a six-volt dry cell battery.

The electrical device consists of an encased six-volt dry battery with transformer and interrupter. The battery is good for about four months; the other parts last indefinitely. (If the electric wire is to extend more than two miles it is advisable to have an electrician calculate the wattage and size of coil needed for the distance contemplated.) Other sources of power may be used, but the dry battery is preferred as being absolutely safe. The outfit can be bought at prices ranging from $12.00 to $20.00. The only maintenance cost would be the cutting of weeds or branches along the fence to prevent leakage.

The idea of placing the electric fence five feet from the regular fence might appear to be fantastic, but there is a reason. When a deer approaches a fence to jump over and finds two fences set five feet apart, he does not like the idea of so long a flat-footed jump. He pauses to pick the line of least resistance. Whether he decides to hop over the single wire or crawl under, he is apt first to make an inspection with his nose or otherwise rub against it and get a violent shock. Cattle thus shocked have avoided the fence long after the discontinuance of an electric current. All live stock, including hogs, respected the fence, and deer, which are very fond of tomatoes and potato vines, were not tempted to eat of the forbidden fruit during a three months' test.

J. G. BURR

GAME, FISH AND OYSTER COMMISSION,
AUSTIN, TEXAS

J. PETER LESLEY AND JOSEPH LESLEY

BIBLIOGRAPHERS as well as geologists should use extreme care when working with papers by either of the Lesley brothers, for the second state geologist of Pennsylvania, who was baptized Peter Lesley, at varying times throughout his life signed his name Peter Lesley, Peter Lesley, Jr., J. P. Lesley and J. Peter Lesley, the "J" standing for junior, while his brother Joseph, also a geologist, sometimes signed his name Joseph Lesley, Jr. The six variations listed above may be considered correct on the basis of actual usage by the individuals, but additional incorrect combinations have also appeared in print. Joseph P. Lesley and Joseph P. Lesley, Jr., each of which has been applied to both brothers, and Joseph Peter Lesley, John Peter Lesley and John P. Lesley which have been used for Peter Lesley, are all incorrect. Not only have wrong names been used in the past but bibliographic references have become badly mixed. Papers written by Peter Lesley have been accredited to Joseph and articles by Joseph attributed to Peter.

A more detailed paper on this problem appeared in the *Proceedings of the Pennsylvania Academy of Sciences*, 1940.

LAWRENCE WHITCOMB

LEHIGH UNIVERSITY

QUOTATIONS

THE BRITISH SCIENTIFIC ADVISORY COMMITTEE

BY means of the Scientific Advisory Committee, the appointment of which is announced this morning, the scientific workers of the country are given a more defined place in the national effort. The distinguished men, acknowledged leaders in their own branches of science, who form the new committee will bring more than their individual, or even their combined, abilities to the services of the nation. They will establish a center and rallying point and be a means of releasing and employing scientific resource and skill. They will also be a channel of communication through which the spontaneous suggestions of scientific workers may be examined and tried.

The advisory powers of the committee will be employed at the instance of the Lord President of the Council, who will indicate particular problems for investigation, or of Government Departments which may ask for assistance in selecting suitable men to undertake particular lines of research. In exercising this function the members of the committee have a knowledge of varied and wide fields of science, and of the men engaged in scientific work, which will give access to resources that, in a mechanical and scientific war, must be utilized to the fullest extent. Here, it seems, the committee is to be at the disposal of the Government.

Even more significant is the conferment on the committee of the duty of seeing that no new scientific or technical developments go neglected. The committee will therefore be a sort of examining board for original ideas, which, passing its scrutiny, will go forward hallmarked for practical experiment or certain use. A clearing house for inventive ideas is not a new provision; but the advisory committee is more than that by reason of its constitution and its powers. It has the responsibility of sifting original ideas and inventions and the highest competence for the task, but it has no need to wait for ideas to reach it from outside. The committee itself is a kind of scientific power house from which great things may be expected.—*The London Times.*

THE FUTURE OF POLISH SCIENCE

SINCE the restoration of Poland after the War of 1914–18 concentrated efforts have been made to develop and coordinate the scientific work of the country. During a difficult period of reconstruction, great progress was achieved and, in addition to the six universities, a number of other centers were available for learning and research. Before the outbreak of the present war, there were approximately 850 professors, 520 assistant professors and 1,600 research assistants and readers; the number of students being about 48,000. With the overrunning of Poland by Germany and the U.S.S.R., systematic and thorough methods have been employed to destroy its scientific life. This is being achieved in German-occupied Poland by the imprisonment of university staffs and scholars, the commandeering of specimens and equipment for use in the German Reich, the destruction of publications and libraries, and the closing of all centers of learning and higher education. Similar conditions exist in Soviet-occupied territory. Professors and research students have no means of continuing their work and the future of Polish science has been further jeopardized by the closing of secondary schools, thus destroying the source of future students. Fortunately, however, some forty-six Polish scientific workers have been able to reach England. They comprise among their subjects, anatomy, zoology, bacteriology, chemistry, physics and branches of engineering and mechanics; the majority can speak at least three languages. It is the Polish Government's earnest endeavor to conserve, through these men, the future of science in Poland. A few will be able to obtain British Council scholarships and will be placed by the council in British research institutions. The remainder will be given partial assistance from the very modest funds possessed for this purpose by the Polish Government.

The difficulties confronting the research workers who have no personal contacts in Great Britain are very great, not least among them the understandable antipathy and mistrust of foreigners which now exists in the country. The importance of securing the future of science and learning in Poland, however, will be fully realized, and by assisting to bring about the admission of Polish workers to research institutions in the British Commonwealth of Nations, British men of science can thus help to ensure a nucleus of Polish intellectuals. Also it must not be forgotten that Poland is an ally of Great Britain, who has at no time and in no way failed her, and that a common bond of hardship has drawn the two countries together in friendship.—*Nature.*

SCIENTIFIC BOOKS

RECENT PUBLICATIONS OF THE BRITISH MUSEUM (NATURAL HISTORY)

THE war has been going on for more than a year, but the British Museum continues to publish valuable works on various aspects of natural history. These publications, at least in the main, represent work done prior to the beginning of the war, but it is the policy to continue scientific work as circumstances permit, work which will have a permanent value when the war is only a matter of history. In the same spirit, the British journal *Nature* frequently reviews German scientific books, accepting them according to their merits, regardless of the conflict between the countries. The books and papers listed below are those which I have just received from the office of SCIENCE.

Karl Fiedler. Monograph of the South American Weevils of the Genus Conotrachelus. February, 1940. 365 pp., many illustrations. Dr. Fiedler, Sanitätsrat in Thuringia, had been studying the South American weevils for a number of years, and a few years ago was invited to revise and describe the material of this large genus which had accumulated in the British Museum. He found in the collection no less than 216 new species, and included in his study about 200 new species obtained from other sources. The complete list, including those previously described, includes about six hundred species. Many of these are important pests of cultivated plants, but for the majority the habits and life history are unknown. The large and well-drawn figures greatly facilitate determination. This excellent book, by a citizen of an enemy country, is published in German. It is remarked in the preface that it would be a heavy expense to translate it into English, and mistakes might be made in the process.

W. H. Evans. A Catalogue of the African Hesperiidae, indicating the classification and nomenclature adopted in the British Museum, 1937. 212 pp., 29 plates. Brigadier Evans, well known for his studies of the Oriental skipper butterflies, undertook to revise those of the African fauna, represented in the Museum by nearly 25,000 specimens, belonging to 70 genera, 421 species and 157 subspecies. The descriptions are very brief, but there are good colored figures of the new species, and of others which had not previously been figured. There are also small diagrammatic figures of the genitalia of all the species. Thus it would seem that it should be possible to recognize the species, and with this aid, a worker in Africa would find ample opportunity to work out the life histories, most of which are unknown. It is a peculiarity of this author (certainly not a policy of the Museum) that when describing new forms, he hardly ever cites the collectors. This is much to be regretted, and I think it would be justifiable to publish an article supplying the missing information. The Museum has depended so much for its rich collections on collectors who have worked, often under very trying conditions, to supply desirable materials that it seems inexcusable to ignore them when publishing their discoveries. There is an excellent bibliography, and when the species have been previously figured, references to the figures are given.

W. D. Lang, Stanley Smith and Henry Dighton Thomas. Index of Palaeozoic Coral Genera. April, 1940, pp. 231. This is, in the main, a carefully compiled and fully annotated index of the genera of Paleozoic corals, but it is of general interest because of the long and very interesting introduction by Dr. Lang, which deals with such matters as the Old and New Paleontology, Polyphyletic Genera, Taxonomy, Nomenclature, etc. When I was a boy, I resided for a time at Margate, on the coast of Kent; the coast which from its white chalk cliffs was long ago named Albion. There lived in the town a Dr. Arthur Rowe, a physician, who took for his hobby the detailed study of the fossils in the chalk. He discovered that this apparently uniform deposit in reality represented a series of epochs, which could be distinguished by their fossils. Rarely has a hobby-horse been ridden to such good purpose. Now, after a long interval, Lang writes under the heading "The New Palaeontology," "Although a new movement can seldom be attributed to one individual, I suppose that no single author, in Britain at least, did so much to introduce the new paleontology as did the late Arthur Rowe in following up the pioneer work of Charles Barrois. His classic work on the sea-urchins of the chalk, published in 1899, at once gave an opening (so it seemed to his generation) to the floods of pent thought which had been accumulating in the minds of many paleontologists, but lacked a means of expression." (The further, highly illuminative, discussion of this topic is too long to quote.) At the end of his introduction, Lang dramatizes the subject as follows: "With due regard to the considerations detailed above, and after more than twenty years of research upon the Paleozoic corals, we enter with some diffidence upon a formidable task. But, after all, the play's the thing; the stage is set, the curtain is rung up. The genera with their attendant genotypes will enter, make their bow, and retiring to collect each its appropriate species, will reappear with them to unfold the evolutionary plot as formation succeeds formation until, in the Permian act, the curtain falls upon an unfinished drama. A coral fauna is there left in the midst of its evolution. Its future is an enigma, and we have no present knowledge as to whether complete extinction overtook it, or whether it underwent a rapid and radical reorganization, to reappear in Triassic times as a fauna of typical Hexacorals."

Thomas Maxwell Harris. British Purbeck Charophyta. 1939, pp. 83 and 17 excellent photographic plates. The subject is treated with beautiful exactness and detail, but it is not found that the Purbeck fossils throw any real light on the evolution of the group. In that remote period were plants with "the vegetative organization of *Chara,* the most elaborate of the modern forms."

Lucien and Jean Morellet. Tertiary Siphoneous Algae in the W. K. Parker Collection. 1939. 55 pp. and six photographic plates. A careful revision, with much interesting detail.

Max H. Hey. Second Appendix to the Catalogue of Meteorites. 1940. 136 pp. Since the publication of the first appendix in 1927, specimens representative of 91 falls new to the collection has been incorporated. The new catalogue lists the meteorites alphabetically under their names (each fall receiving a special name), with annotations. There is a list of meteorite craters, with full references to literature.

Catalogue of the Books, Manuscripts, Maps and Drawings in the British Museum (Natural History), Vol. viii, supplement P–2. Feb., 1940. 515 pp. A great catalogue, invaluable to librarians, curators of museums and others.

Carolus Linnaeus. Systema Naturae. Tenth edition, Vol. 1 (the animal kingdom). 1939. As the tenth edition of the Systema Naturae, the foundation of our binomial nomenclature for animals, had become extremely rare, the museum reprinted it in facsimile, and it can be obtained for the modest sum of ten shillings and sixpence. It should have a great sale in America.

Ruwenzori Expedition. Vol. iii, Nos. 6 to 10. February, 1940. Deals with representatives of five families of beetles found on the expedition to Mt. Ruwenzori in Africa.

The John Murray Expedition. 1933–34. Scientific Reports. These reports, dealing with the work of the expedition in the Indian Ocean, are full of interesting details which invite comment, but we can only enumerate the titles here:

Published October, 1939. Mortensen on the Echinoidea. Chopra (Zoological Survey of India) on the

Stomatopoda. Stanley Gardiner on the Madreporaria and on the Ecology of Solitary Corals. Foxon on Stomatopod Larvae. H. L. Clark (Harvard University) on Ophiuroidea.

Published November, 1939. E. F. Thompson on Chemical and Physical Investigations. Stubbings on Stratification of Biological Remains in Marine Deposits (attempt to determine the warm and cold periods of the past by the foraminifera). Norman on the Fishes. (With a synopsis of the oceanic genera of Brotulidae.)

Published February, 1940. S. J. Hickson on the Gorgonacea, with notes on two species of Pennatulacea.

Published March, 1940. Stubbings on the Cirripedia. Wiseman and Bennett on the Distribution of Organic Carbon and Nitrogen in Sediments from the Arabian Sea. Seymour Sewell on the Copepods, Harpacticoida (a large report, with much interesting discussion).

T. D. A. COCKERELL

AQUATIC PLANTS

A Manual of Aquatic Plants. By NORMAN C. FASSETT. vi + 382 pp. New York: McGraw-Hill Book Company, Inc. 1940. $4.00.

THE aim of this book is to aid in the identification of aquatic plants, whether in sterile or in flowering condition. The forms included are those obvious to the unaided eye and which under normal conditions germinate and grow with at least the base of the plant in water. This interpretation eliminates most of the algae but permits the liberal inclusion of terrestrial forms normally found in moist habitats, thereby greatly increasing the usefulness of the book for general purposes. The region covered includes Minnesota, Iowa and Missouri, then broadens eastward to the Gulf of St. Lawrence and Virginia. A few helpful references are included with each group, and there is a bibliography on the uses of aquatic plants by wildlife.

The volume consists mainly of keys and figures. The former, which include most of the descriptive material, cover more than one hundred pages, while the latter fill considerably over two hundred pages. This liberality of illustration is especially helpful. The figures are original drawings supplemented by a limited number of habitat photographs. In general, the figures are excellent, both in outline and in sampling of detail; a feature of value is the inclusion of the major venation of leaves illustrated. The plate including *Vallisneria* might well be modified, since one drawing involves figures of unequal scale. On the preceding page, in connection with the illustrations of *Anacharis,* terms relating to the elongated portions of the pistillate and staminate flowers appear reversed. A brief appendix dealing with the uses of water plants by animals is both a useful summary and a model of compactness. The portion devoted to fish perhaps merits extension, but this would have involved greater emphasis on algae.

This book is a welcome addition to the literature of aquatic biology. Because of its organization it may be used by the layman, since the author adheres to the plan of aiding the practical worker, but it will be welcomed as well by the experienced botanist. Convenience of the user is greatly facilitated by having keys and figures closely associated. Brevity of treatment is achieved by leaving much to the manuals to which necessary references are made. But the volume is not a crutch to help to bigger books, for its treatment usually affords a satisfying definiteness without supporting references.

ROBERT B. WYLIE

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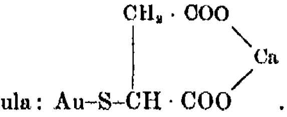
REPORTS

THE COTTON ROOT-ROT TOUR AND CONFERENCE OF 1940

WORKERS on the cotton root-rot disease, caused by ***Phymatotrichum omnivorum,*** assembled for a tour and series of conferences, extending from Greenville to College Station, Texas, August 6–9, 1940. Call for this meeting was issued by Dr. A. A. Dunlap, chairman of the root-rot committee of the Cotton Disease Council. Periodic meetings of this kind, at which research workers on the problem have met to exchange ideas, viewpoints and results, have played a part in the rapid advance of knowledge about this very serious disease. The geographic limitation of the work to Southwest United States has made it possible for a majority of those engaged in studies on the problem to attend some if not all of the conferences. Group discussion of the results and of points to be attacked has doubtless avoided some needless duplication of work, aided in encouraging a wider range of attack on the problem, and has obviously facilitated rapid confirmation of new findings.

The root-rot conferences were at first winter meetings with more or less formal reports of progress. The series began with a meeting at College Station on December 13–15, 1927. Accounts of the meetings and abstracts of papers presented at the second to fifth conferences (1929–32, respectively at College Station, Temple, College Station, and Austin) were published in *Phytopathology.* The sixth conference, held at pound which, from the total yield and the proportion of gold and calcium in it, probably has the following formula:



$$\begin{array}{l} \mathrm{CH_2\cdot COO}\diagdown \\ \qquad\qquad\quad \mathrm{Ca} \\ \mathrm{Au{-}S{-}CH\cdot COO}\diagup \end{array}$$

. The theoretical yield of calcium aurothiomalate on the basis of complete precipitation is 0.9849 gm per gm of sodium aurothiomalate, and the actual yield was 0.9840 gm. The dry compound is a pale yellow powder which neither changes color nor loses weight after being heated in an oven at 100° C. for 24 hours. It is insoluble in water, alcohol and ether, but is completely soluble in tenth-normal HCl. Calcium aurothiomalate forms a uniform and relatively stable suspension in oil of sweet almonds and it was in the form of such a suspension that it was tested for toxicity and therapeutic effectiveness. While an aqueous solution of sodium aurothiomalate administered intramuscularly to 20 gm mice is lethal for 10 to 20 per cent. of animals in a dose of 6 mg, for 30 to 40 per cent. in doses of 7 to 10 mg, and for nearly 80 per cent. of animals in doses of 15 mg, it was found that all 54 mice inoculated with amounts varying from 10 to 250 mg of calcium aurothiomalate remained well over a period of 6 weeks or more without exhibiting any obvious signs of illness. The therapeutic effectiveness of calcium aurothiomalate was determined in 90 mice which were inoculated with amounts varying from 0.25 mg to 20 mg one week after the onset of arthritis. The total dose was administered intramuscularly in one injection. The arthritis disappeared completely in 90 per cent. of 70 mice which were treated with 1 mg or more of calcium aurothiomalate, but in less than 25 per cent. of those which received the 0.5 mg and 0.25 mg doses, and not at all in the 30 control mice which were untreated; 85 per cent. of 20 mice receiving the 1 mg dose made a complete recovery. Under similar conditions, *i.e.*, administering the total dose in one injection, the minimal therapeutic dose of sodium aurothiomalate is 2.0 to 2.5 mg. Calculation would show, therefore, that in mice "the margin of complete safety"[7] is at least 100 times greater for calcium aurothiomalate than for sodium aurothiomalate. A curative effect was also obtained when the total minimal effective amounts of calcium aurothiomalate were divided into ten equal doses and administered at 48-hour intervals. Calcium aurothiomalate was also found to be approximately ten times more effective therapeutically than calcium aurothioglycolate. Insoluble barium and strontium salts of aurothiomalate similar to that of calcium were also prepared, but no comparative study of their biological properties has been made as yet.

At the present time the toxicity of most available gold compounds is perhaps the greatest barrier to their more wide-spread use in the treatment of rheumatoid arthritis in man. There are also certain indications that some of the toxic manifestations in man may be due to sensitization or other factors which may not be measured by the lethal effect of a compound in mice. Only clinical trial, therefore, can indicate whether or not calcium aurothiomalate will be comparatively as safe and effective in human beings as it is in mice.

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[7] The "margin of complete safety"

$$\left(\frac{\text{maximal dose tolerated by nearly 100 per cent. of mice}}{\text{minimal therapeutic dose}}\right)$$

is used here because it describes a property which is different from that represented by the chemotherapeutic index,

$$\left(\frac{\text{minimal dose lethal for 50 per cent. of animals}}{\text{minimal therapeutic dose}}\right).$$

PHOSPHATE ACCEPTORS IN "RESPIRATORY PHOSPHORYLATION" IN MUSCLE TISSUE

IN our studies on the phosphorylation, coupled with the aerobic oxidation of various substrates in cardiac muscle tissue and on the action of enzyme poisons on this process, we used creatine as the acceptor of phosphate.[1] Adenylic acid proved to be a less convenient acceptor, most likely for the reason that it is deaminized. At present we have undertaken a more systematic investigation of the acceptors of phosphate. As the oxidizable substrate we used succinate, the oxidation of which to the fumarate stage is coupled with phosphate esterification, as we demonstrated some time ago.[2, 3] For the experiments cardiac muscle, red muscle and extracts from rabbit's heart have been used; the phosphate acceptors tested were glucosemonophosphate, glucose, glucose + hexokinase (from yeast), glycogen and creatine. In all experiments hexosemonophosphate displayed the most active capacity of accepting phosphate, in accordance with its behavior in brain tissue.[4] No phosphorylation takes place under anaerobic conditions; and in the absence of succinate the esterification is markedly diminished, especially upon addition of sodium fluoride. The products of hexosemonophosphate phosphorylation were shown to be hexosediphosphate (time course of hydrolysis, liberation of inorganic phosphate by phenylhydrazine) and phosphotrioses (alkali-labile phosphoric esters).

Glucose is distinctly esterified, but only in the presence of hexokinase does it become a powerful phosphate acceptor. Glycogen induces a decrease of phosphate that is slower and less dependent on the presence of oxygen than the esterification of hexosemonophosphate. Respiratory phosphorylation in this instance is evidently involved only in the transformation into hexosediphosphate of the glucose monophosphoric ester formed by phosphorolysis. The esterification of phosphate in the presence of different acceptors is shown in Table 1.

---

[1] V. A. Belitzer and E. T. Tzibakova, *Biochimia* (*Moscow*), 4: 516, 1939.

[2] *Ibid.*

[3] Phosphorylation attending the oxidation of succinic to fumaric acid in kidney extracts has also been observed a little later and independently by S. P. Colowick, M. S. Welch and C. F. Cori, *Jour. Biol. Chem.*, 133: 359, 1940.

[4] S. Ochoa, *Nature*, 145: 747, 1940.

TABLE 1

200 mg. Minced Red Muscle of Rabbit. Total Volume 1,7 μl. Succinate 0,05 M, $MgCl_2$ 0,004 μ, Phosphate Buffer 0,015 M (pH 7,4), $NaHCO_3$ 0,008 M. 40 min. at 20° in O_2. Additions: Glycogen 4 mg., Other Acceptors—25 μ M per Sample. H_3PO_4 Disappeared (mg. P)

Without added acceptors	Glucose	Glucose + hexokinase	Hexosemonophosphate	Creatine	Glycogen
0,02	0,04	0,33	0,45	0,13	0,19

In spite of the presence of preformed glycogen in the muscle tissue, esterification was negligible without added phosphatic acceptor: glycogen added artificially is phosphorylated much more readily than the glycogen of the tissue. Hexosemonophosphate, likewise a constant ingredient of muscle tissue, exhibits similar behavior; a rapid accumulation of hexosediphosphate and phosphotriose in aerobiosis takes place only at the expense of added hexosemonophosphate. It is difficult at present to interpret this differential behavior of endogenous and added acceptors.

In several experiments the competition between simultaneously added acceptors was studied. It was found that when glucose + hexokinase and creatine are present together, the latter accepts almost no phosphate, and the phosphorylation of glucose predominates.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE METHOD FOR RECORDING ELECTROCORTICOGRAMS IN ANIMALS WITHOUT OPENING THE SKULL

The following method enables one rapidly to implant electrodes directly in the cortex of small laboratory mammals by the simple method of thrusting Victrola needles through the skull. The needles may then be connected by wires to suitable recording or stimulating apparatus.

Common steel Victrola needles (Fig. 1a) if heated red in a Bunsen flame for a few seconds lose their brittleness. The needle then is wrapped tightly with fine copper or silver wire from the lower part of its thickened shank to within about 5 mm of its top (Fig. 1b). It is well to let one end of the coiled wire extend for several inches from the shank so that clips connected to the recording apparatus can later grip the wire, thus making a flexible, non-rigid connection which will prevent pull on the implanted electrode. The needle and its wound wire is next dipped into enamel and baked, thus insulating it from subsequent contact with scalp and muscle. The point is scraped bare of enamel for a millimeter or so at the tip, and after sterilizing in alcohol the upper part of the shank is gripped firmly in a simple hand chuck by which the needle can be thrust through the skull.

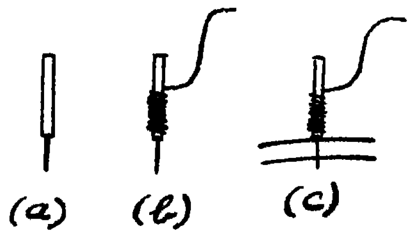

Fig. 1

The scalp and underlying muscles of the skull of the anesthetized animal are separated by a very small sterile incision 5 or 6 mm in length. The head is held firmly in one hand, the incision is spread, and the needle, gripped by the chuck, is thrust firmly through the bone by a straight downwards and rotating thrust. The enlarged shank of the needle stops the point just below the skull surface in the cortical layers (Fig. 1c). Needles thus imbedded are held firmly fast in the bone. The chuck head is carefully unscrewed so as not to loosen the needle in the bone, and the incised tissues are allowed to fall back around the projecting shank which is insulated from them by its enamel coating. A drop of collodion may be applied to the place of entry of the needle. This quickly hardens, helping to brace it and at the same time seal the slight wound from air.

Several dozen of these electrodes can be prepared in an hour and 5 or 6 of them can be implanted in almost as many minutes. When the animal recovers from anesthesia its behavior is normal and the projecting shanks appear to cause no inconvenience. Electrocorticograms recorded from them in unanesthetized rabbits, cats and rats are in all respects identical with those recorded from the exposed cortex. The method is much to be preferred to recording through skull and scalp by electrodes pasted on the skin. Electrode artifacts, troublesome with this latter type of lead, never appear, localization is precise and the lack of resistance of skull and scalp with the needle, sufficient, in some animals, to make external recording impossible, permits one to record at very low amplification, thus eliminating instability and pick-up artifacts accompanying high amplification. The Victrola needles may be left *in situ* for a considerable period, a thing not possible with those externally applied to the skin.

The leads may be removed without reanesthetizing the animal by simply extracting each one by a firm jerk with a pair of pliers. This extraction appears to be painless. A drop of collodion placed on the small hole rapidly seals it off.

We have kept animals for several days with the leads in place and could have kept them longer. Some 50 electrode insertions have been made in a dozen animals without complications from infection. The electrode positions in the cortex could presumably be precisely determined if one wished in the freshly sacrificed animal by passing an electrolytic (D.C.) current through each lead in turn as cathode, thus producing a deposit of iron oxide at the point of contact with the cortex.

Hudson Hoagland

Clark University

AN INEXPENSIVE MOUSE CAGE

It is often desirable to keep mice in small groups when they are under observation. This requires a number of small cages, which should be easily cleaned, and, if possible, inexpensive. The following cage is suggested for its simplicity, ease of cleaning and cheapness. The materials used are few and obtainable at any hardware store. They are as follows: coarse wire netting, sometimes called hardware cloth, 8 inches × 22 inches, two tin pie plates, 8½ inches in diameter and about 20 inches of 24-gauge soft wire.

The ends of the hardware cloth are brought together to form a cylinder, 6½ inches in diameter. By overlapping the ends one inch and weaving a length of the soft wire in and out through the meshes of the cloth they can be made secure. This is best accomplished by weaving down one side and up the other of the overlapping ends so that the ends of the wire may be brought together near one point and twisted. The cylinder thus made will fit into the bottom of one of the pie plates. The other plate is now placed over the open end of the cylinder, thereby completing the cage.

As many as six mice may be kept in the cage at one time with no danger of them pushing off the top plate. Rats may also be kept in like manner, but it is suggested that a lead weight be soldered on the plate which is used for the cover. The plate used for the bottom should be covered with a piece of 25 cm filter paper, which absorbs moisture and assists the sides of the plate in preventing the scattering of food. To clean the cage the paper is removed and fresh put in its place. The mice will tear the paper to some extent, but if they are well fed this is reduced to a minimum.

A drinking fountain may be made by inserting in a small, wide-mouthed bottle a one-hole rubber stopper fitted with a short length of small bore glass tubing. A bit of rust-resisting wire, such as nichrome, should be fastened in the tube to assist in the flow of water when the mouse is drinking. The fountain should be hung inside the cage by means of a wire sling.

Any other dimensions may be substituted for these suggested so that larger or smaller cages may be made. The total cost of the cage described is about twenty cents, and a half dozen can be made in an hour.

E. Wilbur Cook, Jr.

Centre College

BOOKS RECEIVED

Baitsell, George A., Editor. *Science in Progress.* Second series. Pp. xii + 317. 129 figures. Yale University Press. $4.00.

Baver, L. D. *Soil Physics.* Pp. xi + 370. 70 figures. 4 plates. Wiley. $4.00.

Cambridge Philosophical Society, Proceedings. Volume 36, part 4. Pp. 387 + 512 + vii. Cambridge University Press, London. 10/6.

Cissel, James H. *Stress Analysis and Design of Elementary Structures.* Pp. x + 335. Illustrated. Wiley. $4.00.

Cole, Luella. *The Background for College Teaching.* Pp. xxiv + 616. 43 figures. Farrar & Rinehart. $3.50.

Eisenhart, Luther P. *An Introduction to Differential Geometry; With Use of the Tensor Calculus.* Pp. x + 304. 21 figures. Princeton University Press. $3.50.

Fraenkel, Gottfried and Donald L. Gunn. *The Orientation of Animals.* Pp. vi + 352. 135 figures. Oxford University Press. $6.00.

Hewitt, Redginal. *Bird Malaria.* Pp. xvii + 228. 33 figures. 13 plates. Johns Hopkins Press. $1.10.

Japanese Journal of Astronomy and Geophysics; Transactions and Abstracts. Pp. 330 + 51. Illustrated. National Research Council of Japan, Tokyo.

Mark, H. *Physical Chemistry of High Polymeric Systems.* Pp. x + 345. 99 figures. Interscience Publishers, New York. $6.50.

Moelwyn-Hughes, E. A. *Physical Chemistry; An Introduction.* Pp. viii + 660. Illustrated. Cambridge University Press, Macmillan. $9.50.

Patterson, Austin M. and Leonard T. Capell. *The Ring Index: A List of Ring Systems Used in Organic Chemistry.* Pp. 661. Reinhold. $8.00.

Saulnier, Raymond J. *Industrial Banking Companies and Their Credit Practices.* Pp. xxi + 192. National Bureau of Economic Research, New York. $2.00.

Science Reports of the Tôhoku Imperial University (Mathematics, Physics, Chemistry) First series. September, 1940. Pp. 163–314. 4 figures. Maruzen, Tokyo.

Willis, J. C. *The Course of Evolution by Differentiation or Divergent Mutation Rather than by Selection.* Pp. viii + 207. 10 figures. Cambridge University Press, Macmillan. $3.00.

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THE BEGINNINGS OF SOCIAL BEHAVIOR IN UNICELLULAR ORGANISMS[1]

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By social behavior we mean the behavior and reactions of individuals with relation to other individuals as such; reactions to individuals as individuals, either singly or in combination, not merely reactions to physical forces or to masses present in the environment.

How far down in the biological scale does such social behavior extend? Are social urges and instincts and reactions part of the life of the very cells of which organisms are made? Or are they manifestations only of relations that have first come into existence in the great complexes of cells that constitute higher organisms?

I have of late been forced in the course of investigations to become intimately familiar with the daily and most private life of certain organisms, each of which is a single microscopic cell. The phenomena that thus come under observation throw light on the most primitive manifestations of social behavior. I shall try to present the main features of these phenomena, with certain of the reflections and conclusions to which they give rise. They raise the question: What is the nature of the earliest manifestations of social behavior; and perhaps they help us to answer it. They bear also upon the problem of the unity of the manifestations of life in higher and lower organisms. And they lead to a reconsideration of certain other questions that are related to the problems of social behavior: particularly to a question that has been discussed as the problem of self-consciousness in animals.

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[1] Leidy Lecture, delivered before the section on Natural Sciences of the University of Pennsylvania Bicentennial Conference, Philadelphia, September 18, 1940.

I must, then, first ask you to make the acquaintance of the single-cell creatures about which our discussion will center and to follow some of their manners and customs. These creatures are minute green particles, so small that the single individual is hardly visible to the naked eye: their acquaintance must be made under the microscope. They are animals, although they are green; the green color is due to extremely minute plant cells that are growing within their bodies. They are typical ciliate infusoria. This species has received the name *Paramecium bursaria.* They live in fresh water, among lily pads and other plants. They may be kept alive under the microscope, in a few drops of water, or in a single drop. Their generations may be followed for months or years in the laboratory.

Each of these animals is constructed as a single cell, having one large active nucleus and a very minute reserve nucleus. The individual, though a single cell, is complex in structure, having parts which serve as mouth, as organs of locomotion, as sensory and conducting structures, as secretory and digestive portions.

The manifestations of social life that appear most deep-seated—remaining among the most conspicuous even at the stage which we humans have reached—are those connected with mating and the family. In the infusorian, too, these are conspicuous; they will form the basis of our discussion. We shall try to gain an insight into what might be called the courtship, mating, family life and social system of the infusorian.

In the infusorian, as in man, it is not the custom for close relatives to mate. Families are very large. The single individual, as you know, divides into two; these two soon divide again into four, and this continues, so that in a few days the single individual has produced a large family. Such a family is a set of identical twins, containing not two, not five, but thousands, of individuals. Such a family is called a clone.

The members of such a family do not mate together. But if members of an unrelated family are introduced among them, mating occurs between the unrelated individuals. And the behavior of the organisms leading up to the matings is of an extraordinary character.

On the introduction of unrelated individuals, or on mixing two unrelated families in the same drop of water, there is a sudden and strong reaction. The individuals of the different families cling together. Several individuals of one family may cling to one individual of the second family. These are joined by other individuals of both families. In this way tight groups or clots are quickly formed, many individuals of the two families adhering together as if their bodies were covered with glue. They thus form masses of dozens or hundreds of adherng individuals. (See the photographs of this behavior in the papers of Jennings,[2] 1939 and 1939*a*; these photographs were here shown on the screen.)

In these clotted masses the individuals adhere firmly together, as if covered by some adhesive material. The clinging together is not an active reaction, nor is it brought about by organs of attachment. It appears to be a physical adhesion; any part of the body of one individual thus adheres to any part of the individual of the other family. Often an individual visibly struggles as if trying to escape from the attachment to another individual, but in vain.

The great clotted masses remain thus with the component individuals stuck irregularly together for some hours. Then they begin to break up into smaller clots and often into chains of individuals attached end to end. This breaking up continues perhaps for two or three hours, the clots becoming smaller, until there remain only groups of two.

That is, in the course of this long and irregular adhesion the individuals constituting the two families have paired off, two by two, so that now almost all the individuals are in pairs (see the fourth photograph of those published by Jennings, 1939 and 1939*a*; this was here shown on the screen). In every case the two individuals of any pair are members of the two different families. This is readily demonstrated when the individuals of the two families differ in color or in other ways, as is often the case.

The two mates remain intimately united for 24 to 36 hours. While united they exchange halves of their nuclei, halves of their chromosomes (see the figures published by Chen,[3] 1940: these were shown at this point on the screen). They then separate. Each individual is now a new combination of nucleus and cytoplasm, since each has lost half of its chromosomes and has received half of its mate's chromosomes.

These are the fundamental phenomena, sketched in their simplicity. But, as you will see, the phenomena are subject to many variations and conditions. When the manners and customs connected with mating are observed, one finds them surprisingly complex. There is, as it were, a complicated code of taboos, inhibitions and permissible practices connected with the mating behavior: a complex social system.

It was mentioned at the beginning that members of the same family or clone do not thus cling together and mate, while members of different families may do so. But it is by no means true that members of *any* two different families will mate. Some families quite refuse to unite; if mixed together they continue to swim about freely and indifferently. Members of other families unite readily in the way described.

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[2] H. S. Jennings, 1939, *Genetics*, 24: 202–233; 1939*a*, Introduction (pp. 385–389); *Paramecium bursaria* (pp. 414–431) *Am. Nat.*, 73: 385–456.

[3] T. T. Chen, 1940, *Jour. Hered.*, 31: 185–196, 1940.

This selectiveness is not a temporary matter; families 1 and 2 never mate, no matter how often their members are brought together; and the same is true of families 1 and 3; they never mate. But members of families 1 and 4 clump together and mate whenever they are mixed.

In higher organisms, of course, there are two differing sets of individuals, such that members of one of the sets never unite together, but members of one set may mate with members of the other set. We call these two sets the two sexes.

Is this the situation also in the infusorian? Does family 1 belong to one sex, family 4 to the other sex—so that they will mate together? Do all families that will not mate together belong to the same sex?

There are no visible differences, no structural differences, between the two individuals or families that mate together. So far as one can see the two are exactly alike. But of course there might be chemical differences distinguishing the two sexes.

Whether there are thus two sexes, all families belonging to one or the other, is readily determined by successively mixing different families. Before showing what happens in such successive mixtures the result of the observations may be stated. Prolonged study shows that there are not two sexes. On the contrary, there are four different sets, or in one variety eight different sets, which mate together, or refuse to mate together according to sharply defined rules.

These things are discovered in the following way: Two families, which we may call A and B, mate when mixed together, so that if there are two sexes, A represents one sex, B the other. With family A we mix a third family. These two refuse to mate. This third family must therefore be of the same sex as A. We will call it A1. Next we mix another family, which we may call C, with family A. We find that A and C mate together, so that C would have to be considered, like family B, a member of the opposite sex from A: it should then be of the same sex as B. We try mixing families B and C together. But we find that they mate together. So it is clear that B and C do not belong to the same sex. C does not belong to the same sex as either A or B. It belongs to a third type. A and B mate together and C will mate with either of the two.

We are evidently not dealing simply with two sexes. We have thus far found three types, A, B and C. To each of these belong many families, so that we may distinguish A1, A2, A3, B1, B2, B3, C1, C2, C3, and so on. There are many families that act like A; they will not mate with any other family belonging to the A type, but will mate with any family belonging to the B type or to the C type.

And as we continue making mixtures, we presently come upon a fourth set of families, which we may call D. Any family that belongs to the D set will mate with A or with B or with C, but no two families of the D set will mate together. These creatures are divided into castes, which mate or refuse to mate according to rigid rules. Members of any one set or caste will not mate with other members of that set, but will mate with members of any other set. In the variety with which we have thus far dealt there are just four of these castes.

If we call our four castes by the letters A–B–C–D, the mating relations between them are represented by Table 1 (on the screen).

TABLE 1

	A	B	C	D
A	–	+	+	+
B	+	–	+	+
C	+	+	–	+
D	+	+	+	–

A plus sign indicates that the two sets readily mate together; a minus sign that they do not.

Many different and unrelated families belong to type A, many to type B, many each to types C and D.

How do members of the different castes recognize each other? There must be some chemical or delicate physical differences among the four different types. When two individuals of different type come in contact they stick together just as if their surfaces were covered with a strong adhesive. But when members of the same type come in contact they do not stick together. The adhesion is a reciprocal relation between diverse types, not a general tendency to adhere to objects.

The mating relations between the individuals thus turn out to be somewhat complex, in a systematic way. But the half has not yet been told. As we continue to extend our acquaintance among different families of the green Paramecium, we come upon another set of families that will have nothing to do with the families that constitute the four castes that we have called A, B, C and D. Mix animals of the new set of families with any of those of the four types just mentioned. The individuals pass each other by undisturbed, unmoved—even though they may come into actual contact. There is no adhering together; no forming of clots or pairs.

But members of different families belonging to this second group quickly respond to each other. They cling together, form clots and pair off just as occurs in families of the first group. The families in this second group, like those in the first group, belong to different castes or types. Prolonged study shows that in this second group there are eight different types, in place of the four of the first group. Members of families that belong to the same one of these eight types will not mate together. But they mate at once with members of any of the other seven types of this group, though they will not mate with any of the types of Group I.

If we call the eight types of this second group by the eight letters of the alphabet from E to M, then the mating relations of the eight types to each other are shown in Table 2 (on the screen).

TABLE 2

	E	F	G	H	J	K	L	M
E	−	+	+	+	+	+	+	+
F	+	−	+	+	+	+	+	+
G	+	+	−	+	+	+	+	+
H	+	+	+	−	+	+	+	+
J	+	+	+	+	−	+	+	+
K	+	+	+	+	+	−	+	+
L	+	+	+	+	+	+	−	+
M	+	+	+	+	+	+	+	−

In Table 2 a plus sign indicates that two families of the types indicated readily mate together, while a minus sign signifies that they never mate together.

It is remarkable that in all this complex and rather violent mating behavior, the animals observe rigidly certain hours. The adhesion and mating is limited to certain times of the day. It does not occur in the early morning, nor in the evening after five o'clock, nor in the night. It begins at about 8 or 9 in the morning, but the tendency to unite is then very weak; the animals cling together only faintly, in small groups. As the day wears on the tendency to cling together becomes stronger; large groups are formed, in the way that was shown in the photographs. At about four in the afternoon the tendency to cling together may be seen to weaken. The large groups earlier formed break up, and by 5 or 6 o'clock the individuals have completely separated and are swimming about singly again—except the ones that have already become firmly united in pairs. If in the morning or evening we mix together families belonging to different types, they swim about undisturbed, not adhering together nor forming pairs; though the same families if mixed in the middle of the day at once adhere in clots and masses and form pairs.

The conditions thus far described are not the end of the social complications in our infusorian, *Paramecium bursaria*. The social system is indeed enormously complex. There is still another group of families that will not react or pair with any of the families that belong to Group I, nor with any of those that belong to Group II. But the families of this third group mate together in ways and according to rules that are like those already described for Groups I and II. There is one curious difference, however. In this Group III mating is not limited to certain hours, but will occur at any time of the day or night. In this third group there are, it turns out, just four castes or mating types, as there are in Group I. If we call the four mating types of this group by the letters N–O–P–Q, their mating relations are those shown in Table 3 (on the screen).

TABLE 3

	N	O	P	Q
N	−	+	+	+
O	+	−	+	+
P	+	+	−	+
Q	+	+	+	−

Families belonging to any one type will not mate together. But families of any one of the types will mate with families of any of the other three types.

Thus our microscopic green cells are organized socially into sixteen different mating types, which are divided into three large groups, in the way shown in Table 4 (on the screen).

TABLE 4

A B C D	----	E F G H J K L M	----	N O P Q
I		II		III

Members of any one group will not react or mate with members of either of the other two groups. Within any group there are several mating types—four in groups I and III, eight in group II. These mating types within the groups mate with each other in accordance with the rules already set forth. The entire complex system of mating is indicated in Table 5 (on the screen).

TABLE 5

		I				II								III			
		A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q
I	A	−	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−
	B	+	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−
	C	+	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−
	D	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
II	E	−	−	−	−	−	+	+	+	+	+	+	+	−	−	−	−
	F	−	−	−	−	+	−	+	+	+	+	+	+	−	−	−	−
	G	−	−	−	−	+	+	−	+	+	+	+	+	−	−	−	−
	H	−	−	−	−	+	+	+	−	+	+	+	+	−	−	−	−
	J	−	−	−	−	+	+	+	+	−	+	+	+	−	−	−	−
	K	−	−	−	−	+	+	+	+	+	−	+	+	−	−	−	−
	L	−	−	−	−	+	+	+	+	+	+	−	+	−	−	−	−
	M	−	−	−	−	+	+	+	+	+	+	+	−	−	−	−	−
III	N	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	+
	O	−	−	−	−	−	−	−	−	−	−	−	−	+	−	+	+
	P	−	−	−	−	−	−	−	−	−	−	−	−	+	+	−	+
	Q	−	−	−	−	−	−	−	−	−	−	−	−	+	+	+	−

But the account of social behavior in these single cells is not yet complete. Description has been given of the behavior which culminates at once in the mating of the individuals: behavior that is regulated in accordance with manifold and systematic preferences and inhibitions. In its operation this behavior appears a bit brutal. The individual (I had almost said the victim) is as it were seized and dragged struggling to the pairing. One is reminded a bit of the shotgun marriages of melodrama. This violent character of the behavior is striking as one observes particular individuals. Two individuals of different mating type (but belonging to the same group) are swimming about in the graceful way characteristic of these minute animals. Accidentally they come in contact. Thereupon they stick firmly together by any parts of the body that happen to touch. Both are brought to a halt with a jerk. Each tries to continue in the direction it was going. The stronger one drags the other away against his efforts—drags him backward or sideways. Such an adhesion may finally after a struggle result in a complete mating. Or other individuals get stuck to one or the other of the two, so that several or many individuals become stuck together in irregular ways; they flounder about helplessly. Sketches of such adhering individuals, irregularly united in groups of two or three or four, are given by Jennings 1939 (footnote 2), Fig. 3 (reproduced on the screen). The individuals seemingly fall helpless victims to the mating reactions.

But as in higher organisms, there is other behavior that tends in the same direction, yet is not violent and brutal; behavior that appears merely a preparation for the definitive mating reactions: behavior that may or may not lead to the selection of a mate. This behavior is of a type that tempts one to characterize it as the objective aspect of courting, or perhaps in some cases flirting.

This behavior shows itself, not in great mass reactions such as were earlier shown in photographs, but in the activities of individuals—or rather of pairs of individuals. Two individuals touch each other gently. They do not stick together, but swim off in coordinated motion side by side, continuing in contact. They proceed in a graceful path—a spiral—through the water. They may keep this up for but a few seconds, then separate, or it may continue for a much longer time, leading finally to a mating of the two. Most often, however, this caressing behavior lasts but a few moments, then the two individuals separate—possibly coming together again in a similar way a few seconds later. Sketches of characteristic postures and motions in such behavior are given by Jennings, 1939 (footnote 2), Fig. 2 (reproduced on the screen).

There is great variety in these reactions, the one common feature being that the individuals swim together in a coordinated way, in such a manner as to keep their bodies in contact. The bodies may shift, changing the regions of contact; then the two continue in coordinated motion as before. The two after swimming a considerable distance together may separate for a short distance, then come together again. As the animals swim in a graceful spiral, they make a pretty sight, reminding one of couples in a dance.

Such behavior often occurs in two individuals that belong to different mating types. In these cases the gentle caressing behavior is often after a time replaced by the strong physical adhesion before described, and *the two individuals finally unite in conjugation.*

But such behavior is also seen in pairs of individuals that belong to the same mating type, so that they never finally mate. Such pairs swim about in the varied coordinated way that I have described, but finally separate. It appears that the function of this type of behavior is that of a trial: it gives opportunity for the violent adhesive type to supervene if the two individuals are appropriate mates.

It is a curious fact that although the spectacular clumping in great masses which you have seen in photographs was only recently discovered in these animals, this gentle behavior—courtship or flirting as it might be called—was seen long ago in some of the infusoria. The older microscopists of fifty years ago were a good deal excited about it and its possible psychological implications. One may read a summary of the older observations in the great papers of Maupas[4] published in 1889. Some of the authors described such behavior and its possible, psychological bearing with enthusiasm and exuberance. But zoologists have of late been disposed to frown upon it, to hush it up, pass over it unmentioned. For it is not the sort of behavior that lends itself most readily to formulation in the simple terms that are dear to the hearts of mechanistic biologists—particularly in relation to single cells. Yet this is behavior that does occur in unicellular animals, that is widespread among them, and in relation to the unity of life phenomena among organisms appears of great significance. Certainly any adequate account of the biology of unicellular organisms must deal with these phenomena, as it must also with the entire system of social relations above described.

To complete the sketch of social organization in the infusoria, one other matter is required. Since this organization is based on mating relations, the conditions of youthfulness, adolescence and adulthood play a role. Two mates that unite become the parents of a new generation. After mating is completed, with its formation of new nuclear combinations, the two parents separate, and each multiplies by fission; in this way the two produce a biparental family.

When these descendants of the two parents are tested, they are found to be immature; they do not mate. They are youthful. They grow and multiply; hundreds of successive cell generations are produced, with millions of individuals. All these individuals are in appearance like the two individuals that have mated to produce them. But all are immature; they have nothing to do with mating. If during this period different families are mixed, there is no adhesion, no clotting together, no pairing.

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[4] E. Maupas, *Arch. Zool. Exp. et Gén.*, (2) 7: 149–517.

Months later, among the many individuals of these young families signs of approaching maturity show themselves. In mixtures of different families, a few individuals show a weak tendency to adhere when they touch. In time two or three or half a dozen pairs are formed. This period of adolescence lasts for weeks or months; it lasts for many generations. The tendency to mate becomes slowly stronger, till in time the new individuals show the strong spectacular mating behavior that was first described. The new families are now mature.

When this period is reached it is possible to discover the mating type to which these new families belong. And this enables us to discover the effects of heredity in determining the mating type to which any individual belongs. The two parents of course always belong to different mating types, just as two human parents belong to different sexes. Let us suppose that one was of the type A, the other of type D (as in the case shown on the screen). If these two parents had not mated, but had continued to reproduce without mating, all descendants of A would continue to be of type A, all descendants of D would be of type D. But mating has changed this. After mating the two parents produce descendants that are alike, that are all of the same type. From one pair of parents that are A and D are produced descendants that are all of the A type. From another pair of parents A and D are produced descendants that are all of the D type. In these cases the descendants are all like one or the other of the two parents. Most of the pairs produce families of these types. But a few families whose parents are A and D produce descendants that are all of one of the other two types. Some produce descendants that are all of type B, others descendants that are all of type C (as shown on the screen).

If the parents belong to other types, as A and B or A and C, or B and C or C and D, inheritance occurs according to similar rules. Most of the biparental families produced are like one or the other of the two parents, while a few of them belong to the other mating types, to which the parents do not belong. But in all cases the two families descended from two individuals that have conjugated together belong to the same mating type; so that they do not conjugate together. The two constitute in effect one large family, all of the same mating type.

So at any given time a population of the infusorian, like a population of higher organisms, contains a lot of young, immature individuals, not concerned with mating, a lot of adolescents showing as it were an awakening interest in mating, and a great number of mature individuals, which mate in accordance with the complex social system that has been above described.

The question naturally arises: Does it also contain aged individuals that no longer mate and produce descendants—as does a population of higher animals?

This question has not been fully investigated in Protozoa in which different mating types are known. But the population usually does contain some individuals that are less vigorous than others, as if they had grown old. But these continue to reproduce by division as do both the mature and the immature individuals. Seemingly also they continue to mate. But according to the earlier accounts of Maupas (1889) and of Calkins[5] (1919), in some species at least these less vigorous individuals when they mate do not produce offspring. They do not continue to multiply after conjugation, but soon die. It appears possible that these less vigorous individuals are merely those that have lived under poor conditions and grown sickly. All this is a question that is much disputed among observers of these animals. There is beyond doubt some indication that aged, decrepit individuals are finally produced. By aid of the discovery of the diverse mating types, it is to be hoped that this question may soon be fully settled.

In the population as we find it in nature therefore there occur young immature individuals, adolescents in various grades of development, possibly aged, senile individuals, and mature individuals. Among these mature individuals may be representatives of any or all of the 16 diverse mating types and the three different groups that have before been described.

How far is the situation just described in *Paramecium bursaria* typical for unicellular organisms? Investigation of such matters in the different Protozoa has hardly more than begun. Yet it has gone far enough to show that some such social organization as has just been described is of widespread occurrence among certain classes of Protozoa, particularly in the ciliate infusoria. But the details of organization differ greatly in different species. In *Paramecium aurelia* the extensive researches of Sonneborn[6] (1937–1939) show that there are, as in *Paramecium bursaria*, three groups such that members of different groups will not conjugate together. But any single group is composed of but two mating types—a situation like that in man and higher animals—in place of the four or eight types found in *Paramecium bursaria*. In *Paramecium caudatum*, Gilman[7] (1939) finds a situation in many respects like that in *Paramecium aurelia*. In the infusorian Euplotes there occur, according to Kimball[8] (1939), many different groups and many mating types in a group.

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[5] G. N. Calkins, 1919, *Jour. Exp. Zool.*, 29: 121–156.

[6] T. M. Sonneborn, 1937, *Proc. Nat. Acad. Sci.*, 23: 378–385; 1939, *Am. Nat.*, 73: 390–413.

Turn now to certain general considerations; to interpretations, reflections and conclusions. As to conclusions, the facts speak for themselves so loudly that it is hardly necessary to state them in a general form. *Social behavior is found in organisms that are single cells*; it is even found in what must be called in certain respects a highly complex system.

As to interpretations, you will perhaps agree that in describing these social relations one is tempted to fall into the use of terms that are based on our own human experience, of terms that have a subjective background, terms that relate to conscious experiences. The whole picture tends to emphasize the unity of the biological world in such social relations as those of which I have spoken.

Of course there is no doubt at all that all the manifold social discriminations, attractions and repulsions have in the infusoria chemical or physical correlates; as they have indeed in man also. For many purposes it will be most useful to describe the behavior in terms of these physico-chemical relationships, when they become known; and this is what is usually striven for in scientific accounts. But for other purposes, such as for examining into the question of unity versus heterogeneity in biological phenomena, comparison with conditions in other organisms is required. And when one makes such comparisons, it becomes evident that some of the behavior of these simpler organisms much resembles that which in ourselves has subjective accompaniments, has even conscious awareness of relations. Whether there are faint glimmerings of consciousness in the infusorian we can of course never know.

But one thing we can know. The infusorian has no awareness of the complex social system into which its behavior fits, for the good reason that there is no way *in which it could acquire the data requisite for being aware of it*—even if it has or had the capability of conscious awareness. For to become acquainted with the system, one must subject himself to the experience of all its components and relations, and this the infusorian has no opportunity to do; it can not know the social system because it has never become acquainted with it.

This situation illustrates an important biological principle: a principle that is indicated and perhaps we may say demonstrated and emphasized by many relations in the biology of behavior. This principle is as follows: In evolution, process and action are primary, consciousness, particularly conscious awareness, secondary. Conscious awareness, as of purpose, function or relations arises (if at all) *after* action: after the course of action has become established. The organism first acts, only later—in later generations—does it discover why it acts as it does, what function is performed by its action. Many things that are consciously done by higher organisms are likewise done by lower organisms, but certainly without that awareness of relations which appears to guide them in the higher animals. The performance of an action, even in accordance with a complex system of relations, comes in evolution before there is awareness of the action—or certainly of its relations. The action is not derived from conscious awareness or purpose, but the reverse is true. The action first comes to be performed, later in evolution the organism comes to be aware of it and of its functional relations. So our Paramecium operates on an elaborate system of social relations, of which it can not possibly be aware. Mankind operates on a social system not too diverse from that of Paramecium, but he is aware of it, and sometimes has consciously planned certain aspects of it.

Social behavior—meaning distinctive and specialized reactions to individuals of one's own kind, such as we have seen in the infusorian—implies and is correlated with another aspect of behavior—an aspect which has always been stated in terms of consciousness. It is known as the problem of "self-consciousness." The individual in his social relations reacts as one individual among others, having attributes similar to those of other individuals. Stated in the subjective terms commonly employed, in self-consciousness the individual recognizes himself as a unit in the social group of individuals of his own kind. It has long been the custom to assert that while animals doubtless are conscious, only man has self-consciousness. The possession of self-consciousness has been asserted as a great distinctive feature of man. This is a traditional and hallowed doctrine, one that keeps for man his unique place in nature.

But certainly the objective correlate of self-consciousness is seen in organisms that react socially; organisms that find their place in a social system such as we observed in the infusorian. Such organisms react as members of a particular group; they react to individuals of that group (and of that only) as to fellow creatures of their own kind. In the mating behavior they declare themselves, as it were, to be individuals of the same kind as their mates. In these lowest organisms this is presumably done without conscious awareness of the relations involved. If so it is again an example of the fact that types of action come first, awareness of the relations involved coming later in evolution.

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[7] L. C. Gilman, 1939, *Am. Nat.*, 73: 446–450.

[8] R. F. Kimball, 1939, *Am. Nat.*, 73: 451–456.

In animals that are more complex this type of action has developed in such a way as to indicate that there has arisen conscious awareness of the self as an individual among other like individuals. This is shown in many ways beside the mating behavior; one of the most striking of these is the exhibition of jealousy. When a dog is caressed in the presence of another dog the second dog is disturbed; he seeks to substitute himself for the one caressed. It is difficult to see how a creature that is unable to speak could indicate more clearly that he realizes himself to be an individual like the other dog, that he and the other dog are rivals. Such jealousy, with the same implications, is shown by many of the higher animals.

Related to this, and with a similar significance, are the demands of many of the higher organisms that dominance and subordination be observed; that the rights of precedence be not infringed. Any one who in his youth was accustomed to drive home the cows knows with what indignation it was received when one of the subordinates attempted to go first through the gate. It was quickly put in its place by well-directed shoves from the horns of the cow that had in earlier contests made good her claim to precedence.

This matter of dominance, of group precedence, in animals has of late been studied systematically, so that knowledge of it is by no means now in the anecdotal stage. Bird society has recognized orders of dominance, established originally by contests among individuals. This order of dominance is commonly known as the "pecking order." A certain individual established his right to peck, or to threaten to peck, any of the other members of the flock. The others recognize their subordinate relation and receive the pecking without resistance or resentment. Another individual is No. 2 in the pecking order, and so on down the line, there being a complete hierarchy.

Such demands for precedence, such recognition of one's self as a subordinate, or as occupying a clearly defined place in the social hierarchy, seem clearly to involve a consciousness of the self as an individual among others; or at least they involve the objective correlate of self-consciousness. Unless we arbitrarily deny all consciousness to other organisms than man, we can not consistently deny to them self-consciousness: that is, awareness of the self as an individual among like individuals. The attempts to reserve self-consciousness as a distinctive attribute of man therefore appear to be outmoded; they appear out of touch with scientific knowledge.

Among the many features of social behavior in animals that carry similar implications, doubtless the most primitive is the behavior in seeking mates. It is found generally in unicellular organisms. Indeed it is doubtful whether any organisms exist in which it does not occur. The seeking of mates appears to be the fountain head of both social behavior and self-consciousness. It involves the recognition of mates as of one's own kind; and correlatively the recognition of the self as of the same kind as mates. Here social consciousness and self-consciousness have their roots.

OBITUARY

RODNEY HOWARD TRUE

Rodney Howard True during his active and productive life lived through many stages in the development of botanical science here in America. His contributions, of which there are about seventy listed in the Department of Agriculture catalogue, cover many different phases of botanical work. Always interested in men and in human welfare, he was associated in the various papers with many other prominent botanists of his time. His breadth of interest is shown in his activities, the associations he founded and fostered, the various and diverse character of his publications and, above all, by his sincere and wholehearted appreciation of his associates. It would be impossible adequately to express this humanistic side without diverting too far from the scope of a notice such as this. He helped others often at great personal sacrifice and resigned from the Bureau of Plant Industry to meet a budget cut rather than reduce his staff in salary or number. This was done with no position in sight, for he preferred a personal sacrifice to administrative injustice to the members of his staff. Many people looked to him for scientific advice which he was always ready to give, for help with personal matters and for pecuniary help in times of great need. This trait led him to take an active part in the welfare of federal employes, to work for a better organization of scientific and technical men and to serve on the Committee of 100 of the American Association for the Advancement of Science on scientific research. He was a leader in organizing the Agricultural History Society, founded in 1919 and incorporated in 1924, and was the first president of the society. He also served on the executive committee and was a life member of that organization. He was also a member of the general committee to revise the U. S. Pharmacopœia in the ninth edition.

He was a member and held important offices in many organizations such as the American Association of

University Professors, Botanical Society of America, Ecological Society, American Agricultural History Society, Pennsylvania Botanical Society, Pennsylvania Horticultural Society, Pennsylvania Forestry Association, Philadelphia Academy of Science, American Philosophical Society, Society of Naturalists, fellow American Association for the Advancement of Science; also a member of Phi Beta Kappa, Sigma Xi and Delta Upsilon. He was also on the Advisory Council *of the Allegheny Forest Experiment Station.*

Born in Greenfield, Wisconsin, in 1866, he was graduated from the University of Wisconsin in 1890 with the degree of B.S. He served in the department of botany as fellow and received the M.S. in 1892. Following the lead of so many other American botanists of that period, he went to Leipzig, where after two years' work with Dr. Pfeffer he received the Ph.D. degree in 1895. Having taught in the common schools of Wisconsin and been principal of the Wisconsin Academy at Madison from 1892 to 1893, he was appointed instructor in pharmacognosy in the University of Wisconsin from 1895 to 1896 and as assistant professor from 1896 to 1899. He then lectured in Radcliffe College and Harvard University from 1899 to 1901. At this time (1901) he was appointed plant physiologist in charge of plant physiological investigations in the Bureau of Plant Industry of the United States Department of Agriculture. This division also included drug plant, poisonous plant and fermentation investigations. This position was held until he resigned in 1920. Shortly after he was appointed professor of botany and director of the Botanical Garden at the University of Pennsylvania. This position he held until 1937 when he retired from the professorship but remained director of the Botanical Garden until his death on April 8, 1940.

His botanical publications began with a study of the flora of Madison, Wisconsin, and with studies of the mosses. Undoubtedly he was influenced by Professors Barnes and Kahlenberg in his earlier work. The physiological side was emphasized in such titles as effect of turgor and temperature on growth, electrolytic dissociation, algae and antiseptics, plasmolyzing agents and the poisonous effects of phenol. Drug plants came in at the very first in such titles as betel chewing, drugs of Ceylon and folk materia medica, and in 1904 the drug plant work seems to predominate with papers on cultivation in the United States of such drugs as ginsing, camphor and paprika. Along with these investigations were studies of curing and keeping qualities of lemons. The interest in mosses was still evident, and the swing to plant nutrition evinced very early became dominant about 1914 in such studies as toxicity and malnutrition, harmful effects of distilled water, exchange of ions in nutritive solutions, studies of lime and magnesia, of alkaloids, oxidases and latex and the absorption of calcium salts. Studies of normal and blighted spinach, of the ash of spinach as affected by concentrated solutions, and calcium in the nutrition of plants, of the effect of illuminating gas in soils on plants were gradually giving way to an interest in the history of botany and agriculture. As early as 1916 he published on Thomas Jefferson in relation to botany. Then Lewis and Clark, John Bradbury, Sachs, Michaux and Jefferson claimed his attention. A swing toward horticulture is evinced in later works on pecan, viburnum, Dutch elm and pine diseases and the work of the Morris Arboretum.

In many ways True was a pioneer, pushing into new worlds and reporting back with great enthusiasm, always looking for a new interest but holding to the old with undiminished enthusiasm. This enthusiasm, to a great degree, he could pass to his staff by his ability to lay out and plan experiments backed by an interest in the younger workers which stimulated them by his faith in their ability and evident satisfaction in their accomplishment. This led to a real affection for him by his subordinates. Informal gatherings in the laboratory or greenhouse for discussion of problems brought together men in related fields and did much to maintain a cooperative scientific atmosphere in the Bureau. One of his men, now a prominent botanist, says of him in a personal letter: "I've never known any one who was more generous in his appraisal of his employes or more good-hearted in his relations with them. He was a vigorous champion of research."

With such broad interests, with so much humanitarian interest, his greatest contribution was the opportunity he afforded to others to interest themselves in their own special problems. The list of men who profited by this atmosphere would include many leading American plant physiologists.

Science to True always meant a contribution to human welfare, and the welfare of the scientific worker was always important to him.

H. L. SHANTZ

HOWARD J. BANKER

HOWARD J. BANKER died in his home at Huntington, Long Island, on November 13. He was born in Schaghticoke, New York, on April 19, 1866, the son of Amos B. Banker and Frances Alcena Welling. He is survived by his wife, the former Mary Eugenia Wright, of Clifton Park, New York, and a nephew, Walter B. Banker, of Wilmington, Delaware.

He received his A.B. degree from Syracuse University in 1892 and his Ph.D. from Columbia in 1906. He was pastor of the Union Church in Proctor, Vermont, 1895–98; teacher of mathematics in Dickinson

Seminary, Williamsport, Pennsylvania, 1900–01; teacher of biology, Southwestern State Normal School, California, Pennsylvania, 1901–04; professor of biology, DePauw University, Greencastle, Indiana, 1904–14; investigator in the Eugenics Record Office of the Carnegie Institution of Washington, located at Cold Spring Harbor, New York, 1914–33. He was a member of Phi Beta Kappa and Sigma Xi.

His botanical interests, chiefly in the fungi, found expression in a monograph of the Hydnaceae of North America. He compiled a genealogy of the Bancker or Banker families. His interest thus shown in genealogy brought him to the Eugenics Record Office, where he compiled an extensive history of the Bowditch family of Boston as an example of heredity in an aristogenic family. He invented a method of measuring intelligence on the basis of teachers' marks, and this has been applied to the study of inheritance of mental traits in normal populations. His later contributions were in the field of aristogenic human heredity, and he promoted the introduction of personality traits into family histories in order to render genealogical studies of greater scientific and social value.

ALBERT F. BLAKESLEE

RECENT DEATHS

DR. FRANK M. ANDREWS, professor of botany at Indiana University, with which he had been connected for forty-six years, died on November 26 at the age of seventy years.

MARIUS ROBINSON CAMPBELL, who retired as principal geologist of the U. S. Geological Survey in 1932, died on December 7 at the age of eighty-two years.

DR. JOHN AUGUSTUS HARTWELL, surgeon, of New York City, president of the New York Academy of Medicine from 1930 to 1933 and from 1934 to 1939 director of the academy, died suddenly on November 30. He was seventy-one years old.

DR. PAUL FERDINAND SCHILDER, research professor of psychiatry at the College of Medicine of New York University and clinical director of the psychiatric division of Bellevue Hospital, died on December 8 as the result of an automobile accident. He was fifty-four years old.

DR. JOSEPH BEAL STEERE, from 1879 to 1893 professor of zoology at the University of Michigan, died on December 7 in his ninety-eighth year.

A CORRESPONDENT writes that Dr. James Harvey Ransom, since 1921 professor of chemistry and head of the department at the James Millikin University, died on May 30 at the age of seventy-nine years.

SIR HERBERT WRIGHT, treasurer of the Imperial College of Science and Technology, London, known for his work on tropical agriculture, died on October 28 at the age of sixty-six years.

THE death of Dr. Charles Hesterman Merz, the well-known consulting electrical engineer of Great Britain, and his son and daughter as a result of enemy action is announced in *Nature*. He was sixty-six years old. Dr. Merz was a fellow of the American Institute of Electrical Engineers.

SCIENTIFIC EVENTS

DAMAGE TO SCIENTIFIC INSTITUTIONS IN LONDON

A CORRESPONDENT writes: "A further bombing attack was made upon the British Museum (Natural History) during the night of October 15–16. The building was hit by high explosive and incendiary bombs. The damage was not very extensive and was almost entirely confined to the exhibition galleries, but water seepage was reported to have endangered the insect collections. The zoologists and botanists of every nation, including Germany, would view as a major calamity the destruction of the Natural History Museum and its enormous research collections."

The London *Times* reports that the Royal College of Surgeons, in Lincoln's Inn Fields, was comparatively little damaged when a bomb fell in the garden in the center of the square. Windows and their frames were destroyed, doors and partition walls blown down, and several ceilings damaged. The Hunterian Collection had been removed to a place of safety, but some damage was done to specimen jars, particularly in the army medical war collection.

THE CLASSIFICATION OF TOOL STEELS

THE American Standards Association has announced that it has been requested by the American Society of Tool Engineers to undertake a new project on the classification of tool steels by classes of usage. The purpose of this will be to eliminate the guesswork in selecting the proper steel for various uses, thus prolonging tool life, wearing qualities, etc. This project does not concern tool steels alone but also other materials used for cutting tools, such as cemented carbides and stellite.

According to the American Society of Tool Engineers, there are about 1,000 brands of tool steel on the market, of which many are identical or nearly so. Since there are no standards by which the qualities of these multitudinous brands can be judged and classified, the user is bound gradually to drift into a general use of a certain few varieties of tool steel from which he has happened to obtain generally satisfactory results in the past. Many times, therefore, he may be using the wrong steel for particular applications.

There have been many attempts to classify tool steels by numbering systems or by composition but so far they have been unsuccessful. At present, some steel companies are using a system which classifies tool steels into seven main types, or families, as follows: plain tool steels, oil- or air-hardened die steels for punch press work, oil-hardened die steels for hot work, tough tool steels, high-speed steels, cemented carbides, miscellaneous tool materials, such as "Graphitic Steels." This system of classifying steels has been copied by both manufacturers and users.

The new project for the standardization of materials for cutting tools proposes to index all tool steels by class designation, by manufacturer, by trade name and by classes of usage. The American Society of Tool Engineers believes that this classification of tool steel by types, or uses, rather than by trade name alone will make the choice of the steel for a particular application a simple matter to the user.

THE NEW HYDRAULIC LABORATORY OF THE NATIONAL RESEARCH COUNCIL OF CANADA

THE National Research Council of Canada has recently provided in Ottawa facilities for research on hydraulic structures. Hon. J. A. MacKinnon, chairman of the Committee of the Privy Council on Scientific and Industrial Research, which deals with matters of policy relating to the National Research Council, states that the laboratory has been set up on the recommendation and under the guidance of a committee composed of technical representatives from four Dominion Government departments.

The new laboratory, which is a part of the Division of Mechanical Engineering, has been planned to supplement the limited facilities which are at present available in Canada for work of this kind. Space and equipment have been provided for model research on many classes of hydraulic structure to a scale which will ensure correct flow conditions and freedom from uncertainty regarding "scale effect." The design of structures such as canal locks, dams, spillways, gates and power plant details can be investigated and work may be undertaken on river hydraulic problems of limited extent. Many pipe-flow problems are also within the scope of the laboratory. A feature of the laboratory is the large flow of water available which will be adequate for the largest models that can be accommodated. The present location of the hydraulic equipment is temporary, and the equipment has been designed for more commodious quarters for which plans have been made.

This hydraulic laboratory provides the engineering profession with a useful tool not hitherto available in Canada for the solution of many problems in hydraulic design. Like all the facilities of the National Research Council, the new laboratory is provided to serve the needs of the country, and its facilities are available not only for investigations of national interest, but also for the solution of those specific problems which arise in private industrial development.

THE PROPOSED NEW CANCER HOSPITAL IN NEW YORK CITY

THE Board of Estimate of New York City referred on December 3 to the City Planning Commission between the city, the trustees of Columbia University and the Presbyterian Hospital an agreement which has been under consideration for the last year for the building of a new cancer hospital.

Under this agreement the trustees of the university and the hospital would convey to the city without charge a two-and-a-half acre site adjacent to the Columbia Medical Center, which is valued at $750,000. It is planned that the hospital be ten stories high, large enough to accommodate 315 beds. The total estimated cost is $2,650,000. The capital budget for 1940 of the Board of Estimate includes $350,000 for design and preliminary work, and an appropriation of $600,000 is contained in the capital budget for 1941. The College of Physicians and Surgeons of the Medical Center will collaborate with the Department of Hospitals in the scientific work and in maintenance of the hospital.

The university will nominate the professional staff of the hospital, except for such appointments as are made under the rules of the Municipal Civil Service Commission.

The city is required to build, equip and maintain the hospital. Unless the building is begun within five years of the date of delivery of the deed, the land reverts to the Presbyterian Hospital.

Dr. Willard Cole Rappleye, commissioner of hospitals, who is on leave of absence as dean of the College of Physicians and Surgeons, stated that the hospital should be completed in 1942. If the Planning Commission and the Board of Estimate approve the agreement and the plans, construction will begin in a few months.

SYMPOSIUM ON MALARIA

A SYMPOSIUM on malaria consisting of six programs will be held in Mitchell Hall, College of Physicians Building, 19 S. 22nd Street, Philadelphia, on Monday, Tuesday and Wednesday, December 30 and 31, 1940, and January 1, 1941. The symposium has been organized by Section N (Medical Sciences) as part of the annual program of the American Association for the

Advancement of Science and is jointly sponsored by the American Society of Tropical Medicine, the National Malaria Committee and the American Society of Parasitologists. It represents an encyclopedic coverage of the subject of human malaria as the disease exists in the United States and the regions surrounding the Caribbean. A total of 42 papers has been prepared by outstanding authorities, and the titles are grouped under the following headings: (1) Introduction and Parasitology, (2) Anopheline Vectors, (3) Epidemiology, (4) The Human Infection, Symptomatology, (5) Pathology, (6) Therapy, (7) Control and Eradication.

The desirability of reviewing the present-day knowledge of this disease in the aforestated manner was emphasized some three years ago when reports of the presence of a severe epidemic of malaria in Brazil were made known. The epidemic had appeared subsequent to the introduction of the mosquito *Anopheles gambiae* from Africa to endemic areas in South America. It was apparent to those familiar with the situation that the same tragedy might take place in the United States since malaria is not only indigenous in 36 of the 48 states but deaths have occurred as a result of the infection in practically every state in the Union. On the basis of the experiences in Brazil the sole requirement for its duplication here was the presence of a good transmitter (anopheline mosquito) which might enter accidentally in the ordinary course of airplane transportation. Accordingly an organization committee was appointed by the Executive Committee of the Association to investigate the problem, and the symposium will mark the culmination of two years of active planning by this group.

Investigators in this country have not been callous to the menace of this malady, which is often believed by the laity to be confined to the tropics. From the day when malaria was first recognized as a serious, disabling and frequently fatal disease in the Western Hemisphere, attempts have been made to combat it, and there is some indication that the most malarious areas in the United States are gradually coming under control. Research workers from the various disciplines have been extremely active in contributing to fundamental discoveries in this field; nevertheless, it is recognized that serious gaps exist in our present knowledge of the disease. Even though the causative agent, a microscopic protozoan, was seen and recognized in human red blood cells over 60 years ago, the germ has not as yet been cultured satisfactorily and at will on artificial media; thus, little is known of its food requirements or by-products of growth. Again, the lack of a suitable laboratory animal susceptible to the human parasite is an additional handicap limiting experimental work to studies in man. The present unsettled conditions in the Far East have jeopardized the shipments of the antimalarial drug, quinine. The limited supply of this substance on hand has stimulated a feverish search for a satisfactory substitute. These are some of the urgent problems which will be covered in Philadelphia. It is hoped that the contributions to the symposium will be suitable for publication in monograph form by the association and thus serve as a guide for immediate as well as for future thought and research on this most important disease.

Malcolm H. Soule, *Secretary,*
Section N, A. A. A. S.

THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The 1941 meeting of the Pacific Division of the American Association for the Advancement of Science and its affiliated societies will be held at Pasadena, Calif., from June 16 to 21. The host institutions on this occasion will be the California Institute of Technology, the Henry E. Huntington Library and Art Gallery and the Mt. Wilson Observatory of the Carnegie Institution of Washington.

A preliminary announcement descriptive of the general features of the program will be distributed to members of the Pacific Division early in March.

It is hoped that this meeting will be widely attended not only by members resident on the Pacific Coast, but also by members of the association resident elsewhere in the country.

Members desirous of presenting papers are advised to communicate with the secretary of the society before which the paper will be presented, and to submit titles of communications not later than April 25. Brief abstracts are also requested.

THE COLD SPRING HARBOR BIOLOGICAL LABORATORY

At a recent meeting of the Board of Directors of the Long Island Biological Association the resignation of Dr. Eric Ponder, for the past five years director of the Biological Laboratory at Cold Spring Harbor, was received and accepted with expression of appreciation of his services.

When the laboratory was suddenly bereft of Dr. R. G. Harris's services, Dr. Ponder assumed charge and carried forward the multifarious activities of the laboratory without interruption. He organized and carried through the five symposia on excitation phenomena, internal secretions, the protein molecule, biological oxidations and permeability, the results of which, so far as published, have met with unstinted praise.

Dr. Millislav Demerec, of the Department of Genetics, Carnegie Institution of Washington, was elected director of the laboratory for the year 1941. Dr. Kenneth S. Cole, of the College of Physicians and

Surgeons of New York City, and Dr. G. W. Corner, of the Carnegie Institution, were elected to the board, and the latter to the chairmanship of the Scientific Advisory Committee, Arthur W. Page, under whose presidency the association's activities were developed to a high degree, having resigned due to pressure of other duties, Dr. Robert Cushman Murphy, of the American Museum of Natural History, was elected to succeed him as president of the association.

MEDALISTS OF THE ROYAL SOCIETY

King George has approved the recommendations made by the Council of the Royal Society for the award of the two Royal Medals for the current year as follows:

> To Professor P. M. S. Blackett, F.R.S., for his studies of cosmic rays and the showers of particles which they produce, for his share in the discovery of the positive electron, for his work on mesons and many other experimental achievements.
>
> To Dr. F. H. A. Marshall, F.R.S., for his contributions to the physiology of animal reproduction.

The following awards of medals have been made by the president and council of the society:

> The Copley Medal to Professor P. Langevin, For. Mem. R.S., for his pioneer work in the electron theory of magnetism, his fundamental contributions to discharge of electricity in gases and his important work in many branches of theoretical physics.
>
> The Rumford Medal to Professor K. M. G. Siegbahn for his pioneer work in high precision x-ray spectroscopy and its applications.
>
> The Davy Medal to Professor H. C. Urey for his isolation of deuterium, the heavy hydrogen isotope, and for his work on the use of this and other isotopes in following the detailed course of chemical reactions.
>
> The Darwin Medal to Professor J. P. Hill, F.R.S., for his contributions to problems bearing on the interrelationships of the main groups of the Mammalia and on the phylogenetic history of the Primates.
>
> The Sylvester Medal to Professor G. H. Hardy, F.R.S., for his important contributions to many branches of pure mathematics.
>
> The Hughes Medal to Professor A. H. Compton for his discovery of the Compton effect, and for his work on cosmic rays.

SCIENTIFIC NOTES AND NEWS

Sir Henry Dale, director of the National Institute for Medical Research, London, has been elected president of the Royal Society.

William Benjamin Gregory, professor emeritus of experimental engineering and hydraulics at Tulane University and consulting engineer, was presented with the Worcester Reed Warner Medal at the sixty-first annual meeting of the American Society of Mechanical Engineers. This medal is awarded annually for contributions to permanent engineering literature. It is named in memory of W. R. Warner, co-founder of The Warner and Swasey Company, who was a charter member of the society and its president in 1897. Its establishment was made possible by a provision in Mr. Warner's will.

Dr. William Crocker, director of the Boyce Thompson Institute of Plant Research and president of the Yonkers Board of Education, was the guest of honor on December 2 at a dinner in the City Club, tendered him by the members of the Yonkers Inner Circle, which has designated him as the outstanding citizen of Yonkers.

Francis C. Frary, director of research for the Aluminum Corporation of America, was elected president of the American Institute of Chemical Engineers at the New Orleans meeting. He succeeds Dr. Webster N. Jones, of Pittsburgh. Sidney D. Kirkpatrick was elected vice-president, Stephen L. Tyler was reelected executive secretary, and Carl R. DeLong was reelected treasurer.

The following officers of the New York Academy of Medicine were elected on December 5: *President,* Dr. Malcolm Goodridge, professor of clinical medicine at the Cornell University Medical College; *Vice-president,* Dr. Henry Cave, assistant professor of surgery, Columbia University; *Trustees,* Drs. George Baehr and Arthur F. Chace; *Members of Committee on Library,* Drs. Alfred E. Cohn, Howard R. Craig and Jerome P. Webster; *Members of Committee on Admission,* Drs. J. William Hinton, John E. Scarff, William E. Studdiford and Edward Tolstoi.

Officers of the American Pharmaceutical Association have been elected as follows: *President-elect,* B. V. Christensen; *First Vice-president,* J. K. Attwood; *Second Vice-president,* L. W. Rowe; *Members of the Council,* R. L. Swain, P. H. Costello and F. E. Bibbins. The next annual meeting of the association will be held in Detroit from August 17 to 23.

Walter L. Wirth, superintendent of parks of New Haven, Conn., was elected president of the American Institute of Park Executives at the recent Cleveland meeting.

It is reported in *Nature* that at the annual statutory meeting of the Royal Society of Edinburgh, held on October 28, the following officers were elected: *President,* Professor E. T. Whittaker; *Vice-presidents,* Dr.

Leonard Dobbin, J. A. Inglis, Professor R. Stockman, Professor James Ritchie, Dr. G. W. Tyrrell and Professor C. T. R. Wilson; *General Secretary,* Professor James P. Kendall; *Secretaries to the Ordinary Meetings,* Professor R. J. D. Graham and Professor W. M. H. Greaves; *Treasurer,* Dr. E. M. Wedderburn; *Curator of the Library and Museum,* Dr. J. E. Mackenzie.

CHARLES JOSEPH TILDEN, since 1919 Strathcona professor of engineering mechanics at Yale University, has retired with the title of professor emeritus.

THE Council of National Defense, composed of six cabinet members—the Secretaries of War, Navy, Interior, Agriculture, Commerce and Labor, has appointed Paul V. McNutt, Federal Security Administrator, coordinator of "all health, medical welfare, nutrition, recreation and other related fields of activity affecting the national defense."

DR. EUGENE F. DUBOIS, professor of medicine at the Cornell University Medical College, has been appointed chairman of the sub-committee on clinical investigation of the National Research Council. This committee reviews problems submitted by the Surgeon Generals of the United States Army and Navy.

MEMBERS of the faculty of the University of California who will devote part of their time to scientific research on mechanisms and devices of warfare include Dr. Ernest O. Lawrence, professor of physics and director of the Radiation Laboratory at the university at Berkeley; Dr. Donald Cooksey, assistant director of the laboratory, and Dr. Vern O. Knudsen, professor of physics at Los Angeles, and Dr. William Crowell Bray, Dr. William F. Giauque and Dr. Wendell M. Latimer, of the department of chemistry at Berkeley.

DR. HERMON CAREY BUMPUS has resigned as chairman of the Educational Advisory Board of the National Park Service. He is succeeded by Edmund H. Abrahams, of Savannah, Georgia.

DR. ROBERT A. STEWART, who obtained the degree of doctor of philosophy in agricultural biochemistry at the Pennsylvania State College in August, has been appointed biochemist with the Quaker Oats Company, Chicago.

DRS. E. RUFFIN JONES, JR., and Frederick F. Ferguson, of the Norfolk Division of the College of William and Mary and the Virginia Polytechnic Institute, have recently received a grant from the American Association for the Advancement of Science through the Virginia Academy of Science, to assist in their work on the Turbellaria of the Norfolk area.

DR. ARTHUR L. DAY, who retired in 1936 as director of the Geophysical Laboratory of the Carnegie Institution of Washington, lectured before the department of geology of the Ohio State University on the afternoons of December 2 and 3 and before the Society of the Sigma Xi of the university on the evening of December 3. The subjects of the lectures were "Geysers," "Hot Springs and Volcanism" and "The Hot Springs of New Zealand and Yellowstone Park."

DR. A. BAIRD HASTINGS, professor of biological chemistry in the Harvard Medical School, will deliver on December 19 the third Harvey Society Lecture of the current series at the New York Academy of Medicine. He will speak on "The Electrolytes of Tissues and Body Fluids."

DR. G. H. PARKER, of Harvard University, spoke on December 5 at the University of New Hampshire on "A Modern View of the Action of the Nervous System." The address was given under the auspices of the Graduate Science Society as a part of the celebration of the seventy-fifth anniversary of the founding of the University of New Hampshire.

DR. S. R. DETWILER, professor of anatomy at Columbia University, gave on November 25 at the University of Alabama a lecture, under the auspices of the Alabama Chapter of Sigma Xi, on the "Biological Aspects of Vision."

DR. ROSS A. MCFARLAND, assistant professor at the Fatigue Laboratory of Harvard University, gave a lecture on November 8 to a joint meeting of the Union College chapters of Phi Beta Kappa and Sigma Xi on "The Psycho-physiological Effects of High Altitude on the Human Organism." Before the lecture, President Dixon Ryan Fox, of Union College, addressed the societies at a dinner at Hale House.

DR. KARL EVANG, director of public health of the Royal Norwegian Government, gave a lecture on December 9 at Swarthmore College under the auspices of the department of zoology. He spoke on "Problems of Nutrition in Norway Before and After the German Invasion."

THE twenty-ninth annual meeting of the Oklahoma Academy of Science opened at the University of Oklahoma on December 6 under the presidency of Dr. G. L. Cross, head of the department of botany. Dr. George T. Moore, director of the Missouri Botanical Garden, St. Louis, was the principal speaker. His address was entitled "On Being Scientific."

IN conjunction with the medical sessions of the American Association for the Advancement of Science at Philadelphia a discussion on biochemistry and physiology in relation to mental disease will be held on Tuesday, December 31, at 2 P.M., in the auditorium of the Institute of the Pennsylvania Hospital. Dr.

Nolan D. C. Lewis will be chairman, and various aspects of the subject will be discussed by Drs. Detlev W. Bronk, Ernst Gellhorn, R. W. Gerard, Harold E. Himwich, Hudson Hoagland and S. Bernard Wortis. Besides discussion of the papers it is hoped that there will be time for short reports by others present. Those wishing to present such a report should inform Dr. Lewis or Dr. Elliott before the meeting.

ALL meetings of the British Astronomical Association have been postponed until further notice.

THE International Association for Dental Research celebrated on December 10 its twentieth anniversary at the St. Moritz Hotel, New York. Wilmer Souder, of the National Bureau of Standards; Dr. William J. Gies, of Columbia University, president and founder of the association, respectively, and Brigadier General L. C. Fairbanks addressed the meeting.

IT is announced that requests to the National Research Council Committee for Research in Endocrinology for aid during the fiscal period from July 1, 1941, to June 30, 1942, will be received until January 31. Application blanks may be obtained by addressing the Division of Medical Sciences, National Research Council, 2101 Constitution Avenue, Washington, D. C. In addition to a statement of the problem and research plan or program, the committee desires information regarding the proposed method of attack, the institutional support of the investigation and the uses to be made of the sum requested. No part of any grant may be used by the recipient institution for administrative expenses. Applications for aids of endocrine research on problems of sex in the narrower sense can not be given favorable consideration, but the committee will consider support of studies on the effects of sex hormones on non-sexual functions—*e.g.*, on metabolism.

THE Board of Directors of the Josiah Macy, Jr. Foundation, founded by Mrs. Walter G. Ladd in memory of her father, held on November 19 its annual meeting making the tenth anniversary of the official operation of the foundation. Two new members were elected: Clarence G. Michalis and Nelson Macy, Jr. Other members of the board are Robert E. Allen, S. Bayne-Jones, Charles S. Burwell, John Dewey, Harry Emerson Fosdick, Ludwig Kast, Dave H. Morris, Lawrence Morris, Willard C. Rappleye, Dean Sage, Paul H. Smart, Edwin S. S. Sunderland and Samuel Trexler. The following officers were elected: the Honorable Dave H. Morris, *Chairman of the Board;* Dr. Ludwig Kast, *President;* Robert E. Allen, *Treasurer,* and Edwin S. S. Sunderland, *Secretary.* Other officers of the foundation are Lawrence K. Frank, *Vice-president,* and Dr. Frank Fremont-Smith, *Director of the Medical Division.* At the meeting the sum of $50,000 was appropriated in support of research bearing on health problems affecting national defense. Last year $135,000 was appropriated, and during the entire period of ten years, the sum of $1,500,000 has been granted to institutions in the United States and in other countries for research in the field of medicine and health care. Support of work in foreign countries, owing to the international situation, was discontinued a year ago.

NORTHWESTERN UNIVERSITY has received $635,000 from the estate of the late Dr. John S. Appleman. Of this sum $135,000 is restricted to the use of the clinics of the Medical School. A gift of $162,000 has also been received from the Clara A. Abbott trust for the advancement of medical, chemical and surgical science.

AN agreement was signed on December 3 between New York City and the American Museum of Health for the establishment of a permanent health museum in the Medicine and Public Health Building on the grounds of the New York World's Fair in Flushing Meadow Park. Dr. Louis I. Dublin, chairman of the board of the American Museum of Health, and Park Commissioner Robert Moses signed the contract, which provides that the museum will coordinate policies with the Department of Health and the Board of Education to provide instruction in matters of public health. Alterations to the existing structure will be completed on May 1. The American Museum of Health was incorporated in 1937 with George McAneny as president; Frederick Osborn, vice-president, and Sam A. Lewisohn, treasurer. Homer N. Calver will be in charge of the museum.

OWING to reduction in income and shortage of paper, the Scottish *Geographical Magazine* has been compelled to reduce its size and the number of issues per annum. It is hoped to publish annually three issues of forty-eight pages each. It was also found necessary to dispense with the services of a paid editor. J. F. Stewart, a member of the council of the society, has undertaken the honorary editorship in the meantime.

DISCUSSION

COLLECTING PELAGIC FORAMINIFERA

DURING the last few years rather intensive work in submarine geology has been conducted at the Woods Hole Oceanographic Institution under the direction of Henry C. Stetson. In connection with this work study of the Foraminifera contained in the bottom sediments taken from the western North Atlantic has been undertaken by Dr. Joseph A. Cushman, Miss Frances L. Parker and the writer. The immediate purpose of this study has been twofold: first, to determine the distributions, according to depth, temperature, etc., on the continental shelf and slope; and second, to use these data as a yardstick in interpreting environments represented by faunas occurring in sediments of submarine cores and tows. This latter applies directly to the Pleistocene history of the North Atlantic. Another purpose in pursuing such a study is that the data obtained on foraminiferal ecology may be used in interpretation of certain marine sediments of Cretaceous and Cenozoic age.

In submarine cores collected from the continental slope and basin of the western North Atlantic there occurs a fauna of Arctic type, beneath the warm temperate fauna occurring in the sediments at the surface of the ocean bottom. This Arctic fauna is of Pleistocene age and represents different oceanic conditions than those obtaining to-day. In order to interpret accurately the environmental conditions represented by such a series of faunas found in the cores it is necessary to know the ecologic conditions under which the animals live. It is known from the records of the expeditions of the *Challenger, Meteor* and others, that certain species are pelagic in habitat, particularly of the families Globigerinidae and Globorotalidae. It is generally assumed that all other species are bottom-living, and in the case of species having arenaceous tests this must certainly be true. Relatively little other pertinent information appears to have been recorded.

The impression that living pelagic Foraminifera are now rare or almost absent in the waters of the western North Atlantic seems to have gained headway in recent years. This is due to the fact that they have not been observed to occur in plankton tows, especially in the experience of the biologists at the Woods Hole Oceanographic Institution who are doing intensive work on the plankton from the area in question. It is true that most of this plankton is being collected for other purposes and the nets are too coarse to retain Foraminifera. Moreover, preservation of plankton in formalin dissolves the calcium carbonate tests of Foraminifera, due to the acid nature of this preservative. The procedure used in the treatment of phytoplankton, which is collected in fine mesh nets, is even more radical in the use of acid, and under these conditions no calcium carbonate test could possibly survive solution.

During a short cruise of the research ship *Atlantis* made during the early part of August, 1940, the writer successfully collected Foraminifera in zooplankton tows. The tows came from the surface waters above the upper half of the continental slope between north latitudes 37 and 39 degrees. Four samples were taken with fine mesh silk nets of the type ordinarily used for the collection of diatoms (about 150 strands to the inch) at depths of 30, 40 and 50 meters at noon, early evening, midnight and early morning. The content of Foraminifera was relatively small in proportion to the amount of plankton obtained, being a maximum of about 100 specimens in approximately 5 cc of plankton. This material was placed in a 70 per cent. solution of alcohol, which coagulates the protoplasm and does not affect the calcareous test. In the laboratory the material was examined suspended in water after the sample had been washed and the amount of fluid reduced to a minimum.

The species obtained in these tows are *Globigerinoides rubra, G. sacculifera, G. aequilateris, Globigerina bulloides, G. inflata, G. dubia* and *Orbulina universa. Globigerinoides rubra* was by far the most common species, and several specimens of this species retained long, delicate spines protruding from the test (never preserved in bottom samples), in many cases the length of these spines is about three times the diameter of the test. In a great many the coagulated protoplasm was observed protruding from the aperture or partially surrounding the test. In other cases the protoplasm was discovered inside the test after breaking the shell with a dissecting needle. The specimens of *Globigerina dubia* were reddish brown in color; some of these were mounted in tragacanth glue and were white when dry.

Using this technique it will be possible to check the vertical and areal distribution of pelagic Foraminifera and a beginning on this work in the western North Atlantic is planned for the near future. Quantitative and seasonal collecting should give data on the present rate of accumulation of foraminiferal deposits in bottom sediments. These are some of many problems pertaining to the general ecology of the Foraminifera which need extensive study.

FRED B. PHLEGER, JR.
WOODS HOLE OCEANOGRAPHIC INSTITUTION

ON THE SPECIFICITY OF RENIN

IT has been found that by the action of the kidney protein renin on a blood globulin a thermostable pressor substance is formed (angiotonin[1]), or hypertensin.[2, 3, 4] Crystalline derivatives of this substance are reported to have been obtained by Page and Helmer.[1]

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[1] I. H. Page and O. M. Helmer, *Jour. Exp. Med.*, 71: 29, 1940.

[2] E. Braun-Menendez, J. C. Fasciolo, L. F. Leloir and J. M. Muñoz, *Rev. Soc. Arg. Biol.*, 15: 420, 1939.

[3] J. M. Muñoz, E. Braun-Menendez, J. C. Fasciolo and L. F. Leloir, *Nature*, 144: 980, 1939.

Renin is secreted by ischemic kidneys,[5, 6] and hypertensin is afterwards formed in the blood.[3, 4] Renin is presumably an enzyme and does not act directly on blood vessels but by the intermediation of hypertensin. The hypertensin-precursor in blood was found to increase after nephrectomy and to decrease or disappear after the injection of renin. This fact suggests that there is a slight renin production by normal kidney. Such a production of renin also explains the rise in blood pressure obtained by Govaerts and Muller[7] by grafting normal kidneys to nephrectomized dogs.

While the pressor substance was found to be formed by the action of swine renin on the sera of horse, swine, cattle or dog, none was formed with human serum. When, however, human renin was used, hypertensin was formed with the serum of any of the above species.

This peculiar specificity of renin leads to the prediction that no pressor response should be obtained in man when swine renin is injected intravenously. Our experience, while limited to sick men, came to confirm this prediction, although hypertensin injected intravenously to the same subjects caused a rise in blood pressure. Since other investigators may have tested this action we are eager to know of further confirmatory evidence.

JUAN CARLOS FASCIOLO
LUIS F. LELOIR
JUAN M. MUÑOZ
EDUARDO BRAUN-MENENDEZ

UNIVERSITY OF BUENOS AIRES,
JUNE 11, 1940

EXCHANGE PERIODICALS FROM FOREIGN COUNTRIES

THE note in SCIENCE, Vol. 92, November 15, page 452, from the Engineering Societies Library, in regard to the receipt of exchange periodicals from foreign countries (not including the American continents) and the statement that that library has made arrangements to store the periodicals in the country of origin until the end of hostilities, is of great interest to the library of the Marine Biological Laboratory. But is not this decision, asking that all countries that are at war hold their exchange material until hostilities have ceased, somewhat unnecessary at the present time when, as is the case for this library, periodicals from England, Ireland, Wales, Scotland, Australia, Indo-China, China, Tahiti, South Africa, Dutch Indies, India, Egypt, Syria, Newfoundland, Morocco, Portugal, Japan and Siberia are still coming through regularly, though somewhat delayed, and even a few German periodicals are now arriving again by way of Siberia and Japan? The fact that so many countries are able to get their publications through to us has encouraged this library to take a more opportunistic attitude by not stopping in all cases the shipment of exchange material destined for us. This library has asked all its exchange institutions in countries on the continent of Europe to hold their publications but has not as yet made this request to the other countries mentioned above in the hope that the necessity for this may not arise. If and when the necessity arises, a request to have the publications held back will be sent. This is more troublesome and perhaps entails risk, but it appeals to us as a practical method. The above has no reference to the *paid subscriptions* held by this library in foreign countries outside of the Americas, but, in general, the same method for securing the subscriptions continuously or at a later date has been applied.

PRISCILLA B. MONTGOMERY

ANTIQUE GALENICALS

WHILE our British colleagues are deserving of deep sympathy and commiseration in these dark days, one can not feel sorry about their difficulties in obtaining buchu leaves, seneca root, jalap, krameria, galsemium seed, black catechu, aconite, and calumba root, as noted in SCIENCE, October 25, p. 373. Why such antique galenicals are still used by British physicians is hard to understand unless it be on the basis of steadfast British tradition. It seems that if this war has no other good effect, it may at least serve to modernize some features of British therapeutics.

HOBART A. REIMANN

JEFFERSON HOSPITAL,
PHILADELPHIA

SCIENTIFIC BOOKS

MATHEMATICAL PAPERS OF SIR WILLIAM ROWAN HAMILTON

The Mathematical Papers of Sir William Rowan Hamilton, Vol. 2, Dynamics. Edited by A. W. CONWAY and A. J. MCCONNELL. xv + 656 pp. Cambridge: Cambridge University Press. New York: Macmillan. 1940. 50 sh.

THIS impressive book is the second volume of Hamilton's collected papers, the first volume of which

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[4] E. Braun-Menendez, J. C. Fasciolo, L. F. Leloir and J. M. Muñoz, *Jour. Physiol.*, 98: 283, 1940.

[5] K. G. Kohlstaedt and I. H. Page, *Proc. Soc. Exp. Biol. and Med.*, 43: 136, 1940.

[6] L. F. Leloir, J. M. Muñoz, E. Braun-Menendez and J. C. Fasciolo, *Rev. Soc. Arg. Biol.*, 16: 75, 1940.

[7] P. Govaerts and P. Muller, *C. R. Soc. Biol.*, 131: 1311, 1939.

appeared in 1931. It is devoted to the subject of dynamics and so contains that part of Hamilton's work which many students estimate as the most important of his amazing contributions to knowledge. With the exception of a few minor notes, occupying less than ten pages of the present volume, Hamilton's work on dynamics was done over one hundred years ago during the decade 1830–40. It is only now after the lapse of a century, largely due to the physical successes of the theory known as wave-mechanics, that it is accorded the general recognition that its importance deserves. It is for the present reviewer a striking and welcome coincidence that Schrödinger, the founder of the theory of wave-mechanics, is now a professor at the Royal Irish Academy of which Hamilton has been the most distinguished president. The interest of the volume under review is much enhanced by the fact that more than half of it (over 300 pages) has not previously been published.

It would be out of place, even if space permitted, to attempt to give any detailed account of the contents of Hamilton's papers on dynamics. However, as in most mathematical theories, the important central idea may be described so as to be understandable by any interested, intelligent scientist. The simplest mechanical system consists of a material particle moving in some field of force (say the gravitational field of the earth) and the problem of its motion may be looked at from two quite different view-points. We may regard as given the conditions at the start (*i.e.*, the initial position and the initial magnitude and direction of the velocity) and may ask the conditions at some later time; or we may regard as given the initial position and the position at some later instant and may ask the initial magnitude and direction of the velocity. For convenience of reference we term the first point of view the local or differential view-point and the second point of view the ballistic or distant view-point (it being in fact the point of view of a gunner who wishes to hit a distant object). Hamilton's great merit was the emphasis he laid on the ballistic point of view (which led to his discovery of his Principal Function) as opposed to the local point of view which had dominated his great predecessor Lagrange. Once the importance of the Principal Function (which is determined by the initial and final positions of the particle) is realized, the theory of partial differential equations assumes full sway; and the interplay between this theory and the theory of ordinary differential equations (in which the time is the independent or master variable) which dominates the local point of view constitutes the important core of Hamilton's work (which was later perfected by Jacobi). The subsequent development of the Calculus of Variations (which occupies a central position in physical theories) may be largely attributed to Hamilton's work. It is pleasant to be able to say that credit for the recent important developments in this theory must be assigned to American mathematicians (particularly Bliss and Morse). Indeed, one need only point to Birkhoff's work in dynamics and to Morse's emphasis on the "large" as opposed to the "local" point of view, to justify the statement that Hamilton's mantle has fallen upon American shoulders. In this connection we must not forget the important work of Synge (who assisted in editing the first volume of Hamilton's works) on the subject of Hamilton's optical researches.

The physical appearance of the book leaves nothing to be desired. That it could be produced at all in the present difficult times is a real tribute to its publishers. The world of science owes a great debt to the editors, both for their clarifying appendices and for their intelligent restraint.

F. D. MURNAGHAN

THE JOHNS HOPKINS UNIVERSITY

RECENT DEVELOPMENTS IN THE STUDY OF ROCKS

A Handbook of Rocks for Use without the Petrographic Microscope. By JAMES FURMAN KEMP, *sixth edition, completely revised and edited by* Frank F. Grout. viii + 300 pp. New York: D. Van Nostrand Company. 1940. $3.00.

THIS excellent revision of Kemp's well-known book follows much of the plan of the older editions but has been largely rewritten so as to take account of the recent developments in the study of rocks. One who is familiar with the older editions notices that the rather detailed discussion of the chemistry included in the descriptions of the rocks in the older editions has been wisely abridged and assembled in a separate section. The glossary which was very valuable in the old editions has been omitted. Several such glossaries are now available.

This book gives excellent hand specimen classifications and descriptions of the igneous, sedimentary and metamorphic rocks; good brief discussions of the field occurrence, geological relations, and origin of such rocks; and descriptions of the newer methods of study. It includes a chapter on calculations in rock study, and illustrations of rock descriptions.

Much of the text is devoted to the naming and descriptions of rocks, and the classifications adopted are simple but are very well suited to megascopic work by one who is not a professional petrographer. An experienced petrographer can make finer megascopic distinctions and must do so to carry on precise petrographic field work. The sections on the origins of rocks, the relations of rocks to each other, sedimentation, and metamorphism are brief but clear discussions of the subjects and are very well selected to give the student an elementary knowledge of our present views on them.

The book should be very valuable to mining engineers, geologists, and others who are interested in making careful studies of rocks without using the petrographic microscope. It is an excellent text-book for courses in macroscopic petrography.

Esper S. Larsen

Harvard University

SOCIETIES AND MEETINGS

THE AUTUMN GENERAL MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY

An unusual number of important scientific meetings have been scheduled to be held in Philadelphia this fall and winter. Among these were first and foremost the notable Bicentennial Celebration of the University of Pennsylvania with its numerous sections, sessions, lectures and symposia, the semi-annual meeting of the National Academy of Sciences and the annual meeting of the American Association for the Advancement of Science with its many affiliated and associated societies. Under these circumstances, it was feared that the regularly held Autumn Meeting of the American Philosophical Society might not be well attended nor of real importance. But this fear was not justified, for about seventy-five members of the society and one hundred guests, many of them from distant places, were in attendance at the meeting on November 22 and 23. There were three half-day sessions for the reading of papers at which twenty papers were presented, twelve of them by recipients of grants from the research funds of the society. Most of these papers were discussed by persons who were familiar with the subjects presented and the sessions were of correspondingly increased interest. The list of speakers, their topics and the leaders in the discussion of each paper were as follows:

H. P. Robertson, professor of mathematical physics, Princeton University. "Stationary Stellar Systems." Discussed by Dr. Shapley.

K.Aa. Strand,* research associate, Sproul Observatory, Swarthmore College. "The Orbital Motion of Zeta Aquarii." Discussed by Mrs. Gaposchkin.

W. F. G. Swann, director, Bartol Research Foundation of the Franklin Institute. "The Origin of the Secondary Peak in the Rossi Curve for Tin."

S. A. Korff,* research fellow, Bartol Research Foundation of the Franklin Institute; research associate, Carnegie Institution of Washington. "The Production of Neutrons by the Cosmic Radiation." Discussed by Dr. Swann.

Henry A. Boorse,* assistant professor of physics, Columbia University (Barnard College). "Some Problems of Low Temperature Physics." Discussed by Drs. Swann, Aydelotte and Urey.

Oswald Veblen, professor of mathematics, Institute for Advanced Study. "Report on *Mathematical Reviews*."

Franz Boas, professor emeritus of anthropology, Columbia University. "Relation between Physical and Mental Development." Discussed by Dr. Davenport.

Daniel Sutherland Davidson,* assistant professor of anthropology, University of Pennsylvania. "Rock Paintings and Carvings in Western Australia." Discussed by Dr. Kidder.

Mary Butler,* research associate, University Museum, University of Pennsylvania. "An Archeological Survey of the Alta Verapaz, Guatemala." Discussed by Dr. Kidder.

L. S. Cressman,* professor of anthropology, University of Oregon; John Simon Guggenheim Memorial Foundation Fellow, 1940–41. "Studies on Early Man in South Central Oregon."

Edith von Porada,* research fellow, John Pierpont Morgan Library. "The Collection of Cylinder Seals in the Pierpont Morgan Library."

Nelson Glueck,* professor of bible and biblical archeology, Hebrew Union College. "Ezion-geber: Solomon's Seaport." Discussed by Dr. Albright.

T. Leslie Shear, professor of classical archeology, Princeton University. "Résumé of Results of Ten Years' Excavation in the Athenian Agora." Discussed by Dr. Meritt.

A. P. Coleman, lecturer in East European languages, Columbia University. (Introduced by Dr. Prince.) "Sir John Bowring and Slavonic Poetry." Discussed by Dr. Conklin.

William B. Scott,* professor emeritus of geology and paleontology, Princeton University. "The Mammalian Fauna of the White River Oligocene." (Read by title.)

Glenn L. Jepsen, associate professor of geology, Princeton University. (Introduced by Dr. W. B. Scott.) "The Ancestry of the 'Flying' Lemur.'" Discussed by Drs. Shull and Conklin.

William J. Robbins,* professor of botany, Columbia University; director, New York Botanical Garden. "Vitamin B_6 and Growth of Excised Tomato Roots." Discussed by Drs. Bronk and White.

Charles B. Davenport, director (retired), department of genetics, Carnegie Institution of Washington. "Responsive Bone." Discussed by Drs. Weiss and Corner.

Alexander Weinstein,* Zoological Laboratory, Columbia University. "The Geometry and Mechanics of Crossing Over." Discussed by Drs. Whiting and Conklin.

Paul Weiss,* associate professor of zoology, University of Chicago. "Autonomous vs. Reflexogenous Activity of the Central Nervous System." Discussed by Dr. Bronk.

Leonard G. Rowntree,† director, Philadelphia Institute for Medical Research. "The Work of the Philadelphia Institute for Medical Research."

The evening lecture on November 22 was given by Edward S. Corwin, professor of jurisprudence,

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* Recipient of grant from the Penrose Fund.

† Recipient of grant from the Deland Fund.

Princeton University, on "Some Aspects of the Presidency"—a timely and scholarly address on the development of the powers and functions of the President during our national history.

As usual, the social aspects of the meetings of the society were not neglected. All out-of-town members and speakers were guests of the society at the Benjamin Franklin Hotel. An informal dinner preceded the lecture on Friday evening and a reception followed it. Luncheons were served in the Hall of the society on each day of the meeting and, as usual, there were many assurances that the meetings of the American Philosophical Society are the most enjoyable of all.

The whole of Saturday afternoon was given up to an executive session of the society. In addition to regular business a report was made by Mr. W. Stephen Thomas, executive secretary of the committee on education and participation in science on its work during the past year. This work is carried on under the auspices of the American Philosophical Society and with funds furnished by the Carnegie Corporation of New York. It is an attempt to stimulate work in science by amateurs and to cultivate in them scientific habits of thought and work. Philadelphia was thought to be a particularly favorable place to experiment in this field of education because of its long history of amateurs in science and its many clubs and organizations of amateur scientists. A survey has been made by Mr. Thomas which shows that there are in Philadelphia 287 clubs and societies of amateurs, with 32,000 members, in pure and applied sciences. The facts of this survey have been printed in a pamphlet of 44 pages entitled "The Layman Scientist in Philadelphia: A Directory of Amateur Scientific Organizations and Resources in Science" by W. Stephen Thomas.

The committee has also organized four projects in which amateurs may participate in scientific work under the direction of four scientific consultants; these are (1) a project in botany, planned and supervised by Dr. John M. Fogg, Jr., on the blooming and fruiting of native wild plants, with tabulations of dates and weather conditions on charts provided by the supervisor and filled out by the volunteer observers. More than 200 charts were distributed to applicants and 51 have been returned with data on some 85 species. (2) Radio project for amateurs to determine facts concerning the ionosphere through records of radio reception, fade-outs and skip-distance occurrences. Dr. Serge A. Korff planned and supervised this project and prepared a form or log to be filled out by observers. About 200 persons applied for these logs and to date 50 persons have actively cooperated in filling out over 200 of these charts. These observations have been so planned that they provide an important supplement to the work of professional students of radio. (3) A third project for amateur cooperation in science concerns the study of the annual rings of old trees in the Delaware Valley with a view to the correlation of tree ring growth with climatic conditions and records of the weather. This project was proposed and is guided by Dr. E. E. Wildman and several hundred persons are cooperating in studying the rings of stumps and logs of old trees and timbers from ancient buildings. One hundred persons have already reported on such studies submitting charts of the rings or in some cases sections of the trees themselves. (4) Finally, Mr. Roger Conant, of the Philadelphia Zoological Garden, has organized a project for tagging frogs, turtles and snakes and a few singing insects, so that their habits, life histories and migrations may be better known. To date 52 persons have participated in this project and have done careful work and kept excellent records.

A monthly bulletin has been published by this committee and distributed to a large number of interested persons. Numerous meetings of members of the executive staff with various clubs and organizations have occurred; a council composed of several of these organizations has been formed and several meetings held in the Hall of this society. It was the general opinion of those who heard this report that the committee on education and participation in science has made a good beginning on an important project.

In reviewing the society's support of research during the past seven years, Dr. Conklin, chairman of the committee on research, reported that the total sum assigned to research from the Penrose Fund during these years was nearly $475,000, or an average of nearly $68,000 a year. In addition the accumulated income of the Johnson Fund, all of which is assigned to research, has amounted to about $47,000 and during the past three years the research grants from this fund have averaged $13,000 each year. The available income from the Daland Fund for research in clinical medicine has since its reception in 1938 amounted to about $18,000 or $6,000 each year. Thus the total research budget of the society is now about $87,000 a year. The research budget from the Penrose Fund is unrestricted, that from the Johnson Fund is semi-restricted in that it has been agreed that persons working in certain institutions may be regarded as occupying a preferred position, while the income from the Daland Fund is restricted to research in clinical medicine and one institution has for the time being been given a preferred position.

A tabular summary of the research grants made from the Penrose Funds shows that since the beginning of our research program in mid-summer 1933 there have been 485 grants in 32 different subjects for a total sum of $446,882, or a general average of more than $920 per grant. In Class I, Mathematical and Physical Sciences, 135 grants were made in six different subjects for a total sum of a little more than $140,000; Class II, Geological and Biological Sciences, received 236 grants in fourteen different subjects for a total sum of $182,476; Class III, Social Sciences, received 26 grants in history and political science for a total of $20,632; Class IV, Humanities, received 81 grants in nine different subjects totaling $84,713. In addition to the 478 grants in these four classes there were seven miscellaneous grants, which could not be properly classified in any of the classes, for a total sum of a little more than $19,000.

In explanation of the inequality of distribution of research funds to the four classes it was pointed out that this distribution was roughly proportional to the number of applications from these classes; furthermore the committee on research has always attempted to make the grants to the most worthy applicants without reference to the classes or subjects represented.

The funds at the disposal of the Committee on Research are not sufficient to make long-continuing grants and consequently the policy has been to help start or finish worthy projects rather than to furnish continuing support; in only 68 cases have grants been renewed for a second time and only in 23 cases for a third. Likewise, it has not been possible to make grants to pay in whole or in part the salaries of members of the staff of any institution, nor in general to pay living expenses of applicants.

In all cases applicants are expected to specify the uses to which the grant will be put. In general each grant has been used for several purposes, but the principal uses may be classified as follows: assistants, technical, artistic, etc., 213 grants; apparatus and materials, 128 grants; travel and field work, 123 grants; living expenses, 14 grants, and publication, 6 grants.

Recipients are notified that in no case is a grant to be regarded as a gift or charity but rather as an investment in men and projects, which investment is expected to yield returns. No doubt there are many returns of a more or less intangible nature such as the personal education of the recipient, but the most tangible result of any grant is the promotion of knowledge through the publication of research. All grantees agree to furnish an abstract of the results of their researches for publication in the *Year Book* of the society. In *Miscellanea* for 1935 and 1936, there were published 25 such abstracts; in the *Year Books* for 1937, 1938 and 1939, 289 abstracts; and 47 full papers resulting from grants have been published in the *Proceedings* of the society, 6 in the *Transactions* and 3 in the *Memoirs;* while 118 reports of researches aided by grants of this society have been reported at its general meetings. In addition, grantees have reported 236 books and articles published elsewhere which have resulted in whole or in part from grants of this society. Thus practically all grants, except some of those made during the past year for which there has not been sufficient time to expect published results, are represented in these publications. In general this seems to be a fairly satisfactory return on the investments made in our grants-in-aid of research.

Twelve different members of the Committee on Research reported to the society their estimates of the value of the researches in the fields with which they were especially familiar, and as one member said of his own field they might be classed as good and not-so-good. This could probably be said of the grants in all the fields. It is difficult to say what proportion of all the researches could be classed as good, fair or poor, but it is probable that at least three quarters of all would fall in the first two categories. Perhaps this is as good a result as could be expected, considering the fact that the Committee on Research has been inclined to favor applicants who are in small institutions where facilities for research are not good. In all such cases the stimulus to investigator and institution has been an important result and the grant has been regarded as a trust and has been conscientiously used as such. On the whole it may be said that the research program of the American Philosophical Society has been a success and that our investments in men and projects have yielded satisfactory returns.

Edwin G. Conklin

SPECIAL ARTICLES

SUGGESTIONS ON PLANT VIRUS NOMENCLATURE AS EXEMPLIFIED BY NAMES FOR CITRUS VIRUSES

Several systems of nomenclature for viruses have been advanced. The following suggestions have developed out of discussions with a number of my associates who have urged me to publish it for consideration. The following manner of naming the viruses, in my judgment, would combine the best features of Johnson's,[1] Smith's[2] and Holmes's[3] proposals, without the chief objections and difficulties in the application and use of any one of these. It is virtually a simplified Smith's system without the confusion of numbers and Holmes's system without the generic difficulties. In view of our present imperfect knowledge we are not ready for genera in the ordinary concept.

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[1] James Johnson, *Agr. Exp. Sta., Univ. of Wis. Res. Bull.* 76, 1937.

[2] Kenneth M. Smith, "A Textbook of Plant Virus Diseases," p. 101. Philadelphia: Blakiston Company, 615 pp., illus., 1937.

[3] Francis O. Holmes, "Handbook of Phytopathogenic Viruses." Minneapolis: Burgess Publishing Company, 221 pp., 1939.

A classification of submicroscopic entities, using many genera which are based merely on symptoms, is, it seems to me, of doubtful value in that it infers that we know more about these entities inducing these symptoms than we actually do know. It assumes certain close relationship between certain of these entities when, in fact, most of these relationships are still uncertain in general and in most cases totally unknown in any physical or chemical sense. On the basis of symptoms, the virus of psorosis in citrus could be placed in any one of four of Holmes's genera.

What seems at present most needed is an easily applied and simple rule for naming the viruses. In the flux of present research, significant names for use seem more important than systems of classification.

A simple way to accomplish this and combine the good features of the previously proposed methods is to use binomials as suggested by Bennett[4] but to derive the "genus" from the host plant, as do Johnson[1] and Smith,[2] and to use specific names, as does Holmes,[3] instead of numbers. In case viruses have already been described and tenable specific names have already been employed, these may be adopted.

The rule for the names of "genera," as indicated by examples given below, is plain, simple and easily applied. *Add the stem "vir" for virus (Latin neuter) to the Latin genitive of the genus of the host in which the virus was first discovered and recognized, dropping any final consonants that occur in this genitive.* To illustrate from viruses which have recently been named by Holmes, peach rosette virus becomes *Prunivir rosettae,* the raspberry-streak virus *Rubivir orientale,* the beet curly top virus *Betaevir eutetticola,* and potato yellow-dwarf virus becomes *Solanivir vastans.*

These "genera" tell one at once two things which are not evident in Holmes's genera: (1) that this "genus" refers to a virus as shown by the ending "vir" from the Latin virus; (2) that it was first recognized and shown by transmission to be a virus in a particular genus of plant. About the worst this rule can do is to make names like Medicaginivir or Chrysanthemivir, neither of which, however, is difficult to pronounce. It will also give many short names, as Zeaevir, Poaevir, Iridivir, Rosaevir, Pyrivir, etc. When the resulting "genus" might rarely have more than six syllables, the final syllable of the genitive may be dropped out. For example, for a new virus of Calceolaria, the derived generic name would be Calceolarivir instead of Calceolariaevir. All these may be considered as Latin neuter nouns.

Specific names of viruses already described may be added to such genera as far as these specific names are tenable, as indicated by the previously named examples. Some already proposed specific names in Holmes's system, however, may need to be replaced because of duplication that would otherwise result.

If authorities are to be cited for these virus names, these derived "genera pro tem" should not be considered in the ordinary taxonomic sense. Since these names are predetermined by the name of the host and since they carry their own meaning, necessary citations need be made only in relation to the names of species, as, for example, *Prunivir rosettae* Holmes[3] or *Prunivir rubiginosum* Reeves.[5] There would be no place for the term "new combination."

I suggest that no suspected virus be given a binomial name merely from observation of certain symptoms or effects in nature which resemble virus diseases until it has been conclusively proved that it is transmissible from plant to plant by budding, grafting, use of insect vectors, mechanical or other means.

Where there are well-marked distinct strains or varieties which need varietal names, these may follow the established botanical procedure. No varietal names, however, should be employed merely for virus strains showing more or less virulence or shownig more or less fluctuation in symptoms unless these produce other proven transmissible persistent differences that enable the virus varieties to be recovered again and recognized. To give varietal names based merely on observation of any of these slight differences in behavior will lead, it seems to me, to meaningless naming and confusion.

The advantages of this manner of naming would be:

(1) Simplicity and ease of application in our present imperfect knowledge of the viruses.

(2) Indication in the ending of the ''genus'' name that it is the name of a virus.

(3) Preservation in the name itself of the first-discovered host relationship of the virus, as in Johnson's and Smith's proposals.

(4) Avoidance of the confusion resulting from numbers, especially in the application of new numbers as is accomplished in Holmes's proposals.

(5) Avoidance of the implication of too certain a generic relationship between viruses producing certain similar host effects, pending more definite knowledge of these viruses.

(6) Furnishing immediate usage of definite predetermined ''genera pro tem'' which can be easily replaced without change of specific names by another set of genera, if need be, when sufficient knowledge of the viruses is forthcoming.

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[4] C. W. Bennett, *Phytopathology,* 29: 422–430, 1939.

[5] E. L. Reeves, *Phytopathology,* 30: 789, 1940 (abst.).

In line with this manner of naming, the following designations are proposed for the citrus viruses:[6]

Citrivir italicum (italicum = pertaining to Italy). The virus causing infectious mottling of citrus.[7]

Citrivir psorosis (psorosis, Latin genitive of *psorosis* = of the psorosis disease). The virus causing psorosis of citrus.[8, 9]

C. psorosis var. *vulgare* (vulgare = general, common). The virus of psorosis A, or the common scaly bark type.[8, 9]

C. psorosis var. *anulatum* (anulatum = with a ring). The virus of psorosis B, a distinctly different type from A.[8, 10]

Other forms which are believed to be due to varieties of the psorosis virus pending further evidence are "concave gum," "blind pocket," "crinkly leaf" of lemon and "infectious variegation."

There are still other virus-like effects in citrus in which viruses are suspected but about which insufficient knowledge regarding transmission is known to justify virus names at present. Some of these are leprosis of Florida and South America, cyclosis of Brazil and concentric ring blotch of South Africa. In this connection it should be pointed out that there is no known experimental evidence to justify Atanosoff in listing as virus diseases a number of other things on citrus. To list certain effects as virus diseases merely because they have no known causal agent serves no useful purpose and tends to fill the literature with misleading erroneous citations.

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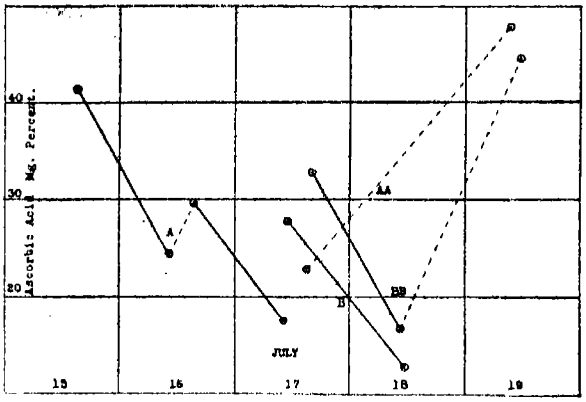
SOLAR RAYS AND VITAMIN C

In an attempt to correlate the ascorbic acid content of young tomato plants of different varieties with the Vitamin C content of the tomatoes they produce, we have discovered a striking relationship between solar irradiation and ascorbic acid content in the plants.

Tomato seeds were planted on June 4, 1940; 24 plants of each variety transplanted into separate flats on June 14. They were kept in the greenhouse until June 26, when the flats were placed in the open. Five flats (Group A) were brought into the laboratory on July 15 and five additional flats (Group B) on July 17, for ascorbic acid studies. On Chart 1, graphs A and B represent the values when single whole plants, cut off at the ground (about 10 g), were used as samples. For graphs AA and BB the upper portions of 3 to 5 plants (about 10 g), from just below the two upper side leaves, were used. Since variety showed no consistent effect, averages of the five varieties at each time of analysis are indicated. Between points connected by solid lines the flats were in the laboratory, with diffuse sunlight during the daytime, while between points joined by broken lines they were in the open on the roof.

Chart 1.



It is evident from Chart 1 that there was a rapid loss of ascorbic acid when the plants were kept in the laboratory over night, and a rapid recovery when the plants were exposed to direct sunlight.

This observation raises the question of the role of ascorbic acid in plant life, about which little is known in comparison with our knowledge of its functions in animal physiology. The loss of Vitamin C in market vegetables is commonly ascribed to atmospheric oxidation. The much more rapid losses in these growing plants suggests its use in some physiological process, with solar rays as essential to its production.

We also have evidence of a positive correlation between ascorbic acid and sugar in the ripe tomato fruit. Is it possible that ascorbic acid is a step in the formation of other carbohydrates? We present these data in the hope that others may carry such studies further, since they are beyond our province.

Edward F. Kohman
Donald R. Porter

Campbell Soup Company,
Camden, N. J.

INEFFICACY OF PANTOTHENIC ACID AGAINST THE GRAYING OF FUR

György and Poling have recently reported[1] the results of studies which indicated that pantothenic acid has a curative effect on the nutritional achromotrichia of rats maintained on a diet devoid of pantothenic acid. These results are in apparent conflict with observations made in the writer's laboratory. In our experiments, neither pantothenic acid concentrates nor pure pantothenic acid exhibited a preventive or curative effect on the gray hair of rats, although the rate of growth and the length of life were greatly enhanced. Evidently, some other circumstances which we can not as yet define influence the occurrence of achromotrichia. We note that our diet differs from that of György and Poling most conspicuously in the substitution of 8 per cent. butter for 2 per cent. corn oil. Such a difference might result in significantly differing amounts of the factor described by Nielsen, Oleson and Elvehjem.[2]

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[6] Because of limitations of space, at the suggestion of the editor the detailed descriptions of these viruses are omitted. These are being submitted to *Phytopathology*.

[7] T. Petri, *Bol. R. Staz. Pat. Veg.*, n.s., 11: 105–114, 1931.

[8] Howard S. Fawcett, "Psorosis: In Citrus Diseases and Their Control." 2nd ed., pp. 188 to 203. New York: McGraw-Hill Book Company, 1936.

[9] *Idem, Phytopathology*, 24: 659–668, 3 figures, 1934.

[10] *Idem, Phytopathology*, 28: 669, 1938 (abst.) and 29: 6, 1939 (abst.).

[1] P. György and C. E. Poling, Science, 92: 202, 1940.

Our rats in which graying of hair occurred were maintained on the following basal diet: sucrose (or starch) 76 per cent., purified casein 18 per cent., salts 4 per cent., and corn oil 2 per cent., supplemented with 24 micrograms B_1, 40 micrograms B_2, 50 micrograms B_6, 6 mgs nicotinic acid and 6 mgs choline every other day and two drops of halibut liver oil weekly.

Group 1. Five litter mates, 2 black, 1 piebald, 1 tan and 1 white, received the basal sucrose diet. The two black rats as well as the tan one received, in addition to the above vitamins, every other day, 0.571 mg of Ba pantothenate of 40 per cent. purity derived from natural sources. Gray hair was observed in both black rats on the 16th day after the Ba pantothenate was first instituted and persisted until the experiment terminated four and one half months later. The tan rat on Ba pantothenate showed no changes in the fur. The white and piebald rats which received no Ba pantothenate developed a "rustiness" of the fur around the head on the 20th and 27th day, respectively.

Group 2. This group was composed of seven black littermates. Five of them were maintained on the above basal sucrose diet, while the remaining two received a basal diet in which methanol extracted starch was substituted for the sucrose. Three of the five rats on the sucrose diet received, in addition to the above vitamins, 4 mgs of methanol starch extract every other day. All five rats on the sucrose diet developed gray hair by the 28th day of the experiment. Two days later the starch extract was discontinued in the three rats receiving this supplement and two days later all seven rats were thereafter given 500 micrograms Ba pantothenate of 40 per cent. purity every other day. On the fifth day after the institution of Ba pantothenate, graying of the fur was observed in the two rats on the extracted starch diet. Two of the sucrose rats also showed "rustiness" of the fur about the head while on the Ba pantothenate. Twenty-five days after the institution of Ba pantothenate, 4 gms of wheat bran extract were given every other day to the three rats which had originally received the starch extract and to one of the rats on the extracted starch diet. The graying persisted in all rats during the subsequent six weeks. At this time pure Ca pantothenate became available and was substituted for impure Ba pantothenate in the amount of 200 micrograms Ca pantothenate every other day. Four of the rats on the sucrose diet and one on the extracted starch diet showed no improvement in gray hair during the subsequent two weeks, while the remaining two rats, one on sucrose and wheat bran extract and one on the extracted starch diet and wheat bran extract, showed a general decrease in graying.

Group 3. Thirteen black rats were maintained on the above sucrose diet supplemented with 6 mgs vitamin C, 200 micrograms vitamin K and 500 micrograms Ba pantothenate of 40 per cent. purity in addition to the previously mentioned vitamins every other day, and 21 mgs alpha tocopherol and 350 mgs linseed oil weekly. In addition, four of the rats received 2 gms waste cane molasses, three received 4 cc steep water, a by-product of starch manufacture, and three were given 400 mgs wheat germ every other day. Five weeks later, pure Ca pantothenate became available and was substituted for 40 per cent. pure Ba pantothenate in the amount of 200 micrograms every other day. By the 11th day after Ca pantothenate was first instituted, all the rats receiving wheat germ and steep water, one of the four receiving molasses and one of the three receiving none of these special supplements developed gray hair. On the 25th day, graying was observed in the remaining three rats on molasses and in one of the two remaining rats receiving none of the special supplements. The other rat of this latter group never developed gray hair.

The pantothenic acid salts used were kindly supplied in part by Merck and Company, Inc., Rahway, N. J., and in part by Professor R. J. Williams, of the University of Texas.

R. R. WILLIAMS

SUMMIT, N. J.

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[2] E. Nielson, J. J. Oleson and C. A. Elvehjem, *Jour. Biol. Chem.*, 133: 637, 1940.

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RECENT GENERAL TRENDS IN MATHEMATICS[1]

By Professor ARISTOTLE D. MICHAL

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EXCEPTING some comparatively isolated researches in elementary geometry and algebra, mathematical research in the first decade of the twentieth century was largely concerned with subjects whose roots were in the theory of functions of real or complex variables and in a large number of special functional transformations of such functions. It is true that in both America and Europe, the mathematical world was then dimly aware that there was such a thing as a theory of functions of abstract (or general) variables, but outside of a few distinguished workers, notably E. H. Moore in America and M. Fréchet in Europe, no one seemed to have done anything about it. This trend towards general function theories made itself felt during the next two succeeding decades in certain branches of functional analysis, topology and algebra. It was not, however, until the last ten years that general analysis and general algebra permeated, or at least influenced, practically every nook and corner of mathematics and symbolic logic. The American and Polish schools of abstract thought have played a leading role in this development. It is gratifying to see that a large number of young men in American centers of learning are making important contributions to general analysis and general algebra. In the interest of clarity it should be remarked in this connection that excellent progress has been made during the last decade in the theory of functions of real and complex variables and their application to various topics in functional equations, to the calculus of variations and to classical differential geometry. The point we wish to emphasize here, however, is that much of this progress was directly or indirectly inspired by ideas current in general analysis.

One of the reasons why general analysis and general algebra are so far-reaching and very concrete indeed when understood is that one can, by special interpretation of a few general variables and operations, obtain old as well as numerous new results by methods that brush aside the unessential and historically accidental. For example, theorems on functional equations $y = f(x)$ in abstract linear metric spaces can by a few master strokes be made to furnish results in such diversified fields as simultaneous equations in real, complex and hypercomplex variables, ordinary differential equations, partial differential equations and integral equations.

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[1] An address delivered by invitation at the University of Illinois, April 30, 1940.

One of the most dramatic examples of the influence of general function theory on a branch of mathematics is furnished by coordinate geometry and differential geometry in particular. The words and phrases coordinates, coordinate systems and transformations of coordinates are on the lips of every student that takes the most elementary college mathematics courses. I say "on the lips of every student" but not "understood by every student" for the simple reason that these notions have only recently emerged from prison walls of philosophical and physical fog into the clearer realm of mathematical thought. It must be recalled that previously the same prison walls had kept fettered the whole subject of geometry until the dawn of our present century, when it became increasingly clear that geometries as mathematical subjects must be developed from a set of postulates concerning classes of more or less undefined (abstract or unspecified) objects. The points of a geometry are undefined, but so are certain distinguished coordinate systems. For example, in plane Euclidean geometry of freshman and sophomore fame, a rectangular cartesian coordinate system is a name given to a postulated single valued function $x(P)$ defined over the whole Euclidean plane and having values in the class of matrices $x = (x_1, x_2)$ with real number elements x_1 and x_2, called rectangular cartesian coordinates of the point P. The function $x(P)$ of the abstract variable P is one of a class of such functions that satisfies a few well-known postulates—and outside of the properties demanded by these postulates, the function $x(P)$ is unspecified. In other words, a rectangular cartesian coordinate system is a mathematical "camera" that photographs the whole Euclidean plane and produces a photograph containing the whole world of matrices $x = (x_1, x_2)$. The nature of this mathematical camera is left unspecified—it is merely required to do the job in a manner specified by the postulates. Other coordinate systems, such as polar coordinate systems, are defined by functions of type $f(x(P))$, where $f(x)$ has arguments and values in subclasses of the class of matrices $x = (x_1, x_2)$. We shall not pursue the subject further—our main object here was merely to indicate how fundamental general function theory is even for the elements of plane Euclidean geometry.

We have already alluded to the influence of general function theory on differential geometry. General function theory enters the subject of finite dimensional differential geometry via the theory of topological spaces and especially through Hausdorff topological spaces. A Hausdorff topological space H consists of a class of undefined elements, called points, and supports a topology determined by a class of undefined subsets of H, called neighborhoods, associated with each point of H such that the following four postulates are satisfied: (1) a neighborhood contains the point of which it is a neighborhood; (2) each point contained in an arbitrarily chosen neighborhood can be surrounded by a neighborhood that is contained in the chosen neighborhood; (3) the intersection of two neighborhoods of a point contains a neighborhood of the same point; (4) each of two distinct points can be surrounded by a neighborhood having no points in common with the other neighborhood. A simple example of a Hausdorff topological space is furnished by the Euclidean plane when neighborhoods of a point P are taken to be the interiors of concentric circles with center at the point P. A coordinate system in a finite dimensional differential geometry is a function $x(P)$, usually required to be a homeomorphism, defined on a subset of a Hausdorff topological space and having values in an n-dimensional arithmetic space, called coordinate space, with points $x = (x^1, x^2, \ldots, x^n)$. In other words $x(P)$ maps a portion of the Hausdorff topological space into a set contained in a class of one-rowed matrices with n real number elements. It is convenient for what we shall have to say later, and in conflict with the usual terminology, to *define the coordinate of a point* P in a coordinate system $x(P)$ to be *the corresponding value of the function* $x(P)$. A coordinate of a point in an n-dimensional geometry *is then,* according to our new terminology, *a one-rowed matrix* of n real numbers. The classical differential calculus for real functions of several real variables now enters the stage and is applied to the differentiability of the components of postulated geometric objects (for example, the components $g_{ij}(x^1, \ldots, x^n)$ of the fundamental metric tensor field in a Riemannian differential geometry) and to the differentiability of the functions involved in transformations of coordinates.

As is to be expected, general function theory plays an even more extensive role in infinite dimensional functional differential geometries. A *coordinate* of a point of a Hausdorff topological space H is now an element of a function space so that a coordinate system $x(P)$ maps a portion of the geometric space H into a class of functions contained in a function space. The differential calculus that is employed in these studies is the classical differential calculus of *functionals.* By a functional we mean here a function whose arguments and values lie in function spaces of functions of a finite number of real variables.

Above all, the influence of general function theory in differential geometry has been felt most strongly in general (abstract) differential geometry, a branch of mathematics which is still in its infancy but which we are convinced is destined to become one of the great branches of mathematics, comparable to the present status of general (abstract) algebra and general analysis. By a *general differential geometry* is meant a differential geometry with an abstract coordinate space. These geometries are *dimensionless* in the sense that the dimensionality of the coordinate space is left unspecified. This makes possible the inclusion of large portions of finite dimensional as well as of infinite dimensional differential geometries as instances of general differential geometries. The abstract coordinate space must be capable, however, of supporting an appropriate abstract differential calculus. It is for this reason that, in the present state of knowledge, the permissible coordinate spaces are topological abelian groups: linear topological spaces and linear metric spaces (Banach spaces). If a general differential geometry has a Banach space as a coordinate space, a coordinate system $x(P)$ maps a portion of the geometric space, a Hausdorff topological space, into a portion of the Banach space, while a transformation of coordinates $\bar{x}=f(x)$ maps a portion of the Banach space into a portion of the Banach space. The function $f(x)$ must in addition have suitable differentiability properties in accordance with the notions of the Fréchet differential calculus of functions with arguments and values in Banach spaces. This makes possible the study of a general tensor analysis and its application to the subject on hand.

One of the interesting features of the work in general differential geometry is that it suggests new advances in the abstract differential calculus, and in abstract differential equations in particular, at almost every turn of the geometrical theory. To a certain extent this is analogous to the situation that must have existed at the time of Gauss and Riemann in finite dimensional differential geometry and the classical differential calculus. Another interesting feature is the large number (roughly 100) of postulates that is required for any one brand of general differential geometry—say, a general Riemannian differential geometry. This is to be contrasted with the handful of postulates required in abstract algebra, say, in group theory.

Mathematical research has profited greatly in the past by the union of two great streams of mathematical thought to form a new vigorous branch of mathematics. Abstract algebra, especially abstract groups, and abstract topology furnish excellent illustrations. What would be more natural than to take the postulates for an abstract group, to add to them the postulates for a topological space and then to require that the group operations be continuous with respect to the postulated topology? The hybrid object that is obtained in this way is now called an (abstract) *topological group*. During the last decade, topological algebras and especially topological groups have been studied with much success for their own sake as well as for the sake of their applications to other branches of mathematics. We have already spoken of the place of topological abelian groups in general differential geometry. This modern work on topological groups has done much recently to clarify Lie's theory of finite continuous groups. There is now in the literature the beginnings of a general theory of continuous transformation groups in abstract spaces with an abstract parameter. The real flavor of Lie's theory lies in its three fundamental theorems, in its differential operators and their commutators and in its structural constants. With the aid of the abstract differential calculus, a certain amount of success has been met in keeping the flavor of the Lie theory in the general theory of continuous transformation groups with abstract parameters. Much remains to be done here.

The applications of group theory are varied and many. The group-theoretic foundations of various elementary geometries have been studied for quite a long while. During the last decade or two much progress has also been made in group-theoretic studies in algebraic geometry and differential geometry. Even if the geometric space of a differential geometry does not have a non-trivial group of automorphisms, there are group-theoretic problems of some importance that arise in such geometries. These considerations would necessitate a radical revision of the seventy-year-old Erlanger Programm. The applications of group theory to physics have been numerous during the last ten years, especially in the quantum mechanics of many electron atoms and of polyatomic molecules. Continuous groups have been used very little in engineering. However, during the last decade many advanced branches of mathematics have found important applications in engineering, and one may suspect that continuous groups would be found helpful in attacking some of the more difficult problems of elasticity, hydrodynamics, aeronautics and meteorology.

There is another aspect of group theory, however, which in recent years has become fascinating. I am speaking here of the applications of various branches of mathematics to group theory. Of course, the application of differential equation theory to continuous groups is well known and we have spoken of the application of topology to continuous groups. Not so well known is the study of topological groups with the aid of the results of modern differential geometry. In fact, a finite dimensional coordinate topological group furnishes a most beautiful and important example of a non-Riemannian geometry, and it becomes Riemannian whenever the group is semi-simple. The theory of integral equations and the modern theory of integrals has been found useful in compact groups. There is a branch of abstract algebra called lattice theory by some and structure theory by others. A lattice is really a generalized Boolean algebra or a generalization of the algebra of point sets. The way in which lattice theory enters into various branches of mathematics is briefly as follows. Many fundamental theorems in a mathematical discipline often deal directly with distinguished subsets of elements rather than with the elements themselves. Now these distinguished subsets in various mathematical domains are found to possess common properties. So there is value in studying a discipline in which an undefined element is abstracted from a distinguished subset of elements of a totally different discipline—and that is what lattice theory does. For example, invariant subgroups are such distinguished subsets of elements in group theory. It is problematical, however, whether pure lattice theory would in the future have as much influence on group theory as some other branches of mathematics have already had.

There are very few branches of mathematics that have not been applied to the solution of problems in the pure physical, biological and social sciences, and the day is dawning when the same could be said about the engineering sciences. I mean this statement to be as sweeping as possible; for there are indications in the scientific literature that show that advanced portions of function space theory and non-linear functional equation theory will, with all their topological paraphernalia, become very useful in practical engineering problems.

Physical and astronomical research from ancient times to the present era has exercised a potent influence on mathematical research. This influence has often been in the form of hunches and heuristic guides. An admirable illustration of this is furnished by the choice of appropriate boundary conditions for a partial differential equation, say, for those equations occurring in potential theory. All this has been common knowledge for many years. There is another side to this influence of physics on mathematics that is not so well known and is taking place right before our eyes. I am referring to some of the misconceptions of physicists that have led mathematicians to start interesting mathematical researches. An excellent example is furnished by the so-called ergodic hypothesis of the classical statistical mechanics. Physicists now seem to be unanimous in their opinion that there is no known physical system that operates under the ergodic hypothesis. Even a hasty survey of the recent mathematical literature shows, however, that mathematicians were first led to the study of the so-called ergodic theorems on linear transformations by their own curiosity concerning the ergodic hypothesis. Another illustration is furnished by the numerous abortive attempts of physicists to manufacture unified field theories in general relativity. All these attempts at a unified field theory seemed to be physically vacuous or untenable, and yet some of the most beautiful work by mathematicians in the field of modern differential geometry was directly inspired by such misconceived attempts.

In conclusion, we would like to make a few more remarks concerning this present-day trend towards more abstract and general work in mathematics—a trend that results more and more in the omission of the real number system as a necessary part of many mathematical disciplines, and a trend that points the way to the Olympian heights of the stately mountain peaks that loom in the ever-widening horizon of the mathematical world. Until rather recently, many mathematical concepts such as limit point, open set, closed set, continuity, differentiability—just to mention a few—were thought to be intimately connected with the real number system. We now know that such is not the case and that these concepts have natural domains of existence that are much more general than real number domains. The methods of proof used in real number theory often have to be radically changed so as to conform to the more general patterns. All this is interesting, and frequently great difficulties arise in the proofs of theorems; but the more novel and often highly original aspects of a general theory are met in the situations which have no real number analogues or in those whose real number analogues are trivial—the latter cases are frequently accompanied by a large number of non-equivalent concepts that become equivalent whenever the domains are specialized to number domains. We have already mentioned the novel contributions of the general theories to the real variable domain and we need not dwell on it here, but merely mention it for the sake of completeness.

PRECIOUS AND SEMI-PRECIOUS JEWELS—THEIR CHEMICAL AND BEAUTIFYING QUALITIES[1]

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IN the time before records primitive man searched for the beautiful and rare. When we come to early writings we read descriptions of gems, and we find examples of these in ancient burials. As man became more civilized, this search for jewels went on with increasing eagerness. Accompanying these early discoveries, and perhaps as a mark of their unusualness, superstition grew up and clustered around these gems. If any think this has died out we need only to call to mind that there are still intelligent people who will not wear opals, considering them bad luck. In less civilized days men and women ascribed all kinds of miraculous attributes to gems, for instance, it being commonly accepted that if one carried a ruby with him, in case of a fall there would be no injury.

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[1] Lecture illustrated by specimens, delivered before Sigma Xi at Purdue University, Indiana University and Union College, and before the Rochester and Cornell sections of the American Chemical Society.

Here in Sigma Xi we are interested in research—the understanding of the present and the development of the new. In the field of our jewels, by the application of the usual principles of scientific analysis and classification, man has been successful in unraveling the determinative qualities of the principal gems. He has also succeeded over the past thirty years in outdoing nature by the making of certain gems, such as rubies, sapphires and spinels. The methods of approach have been the same as in other endeavors. First came careful analysis of the chemical and physical qualities which give to gems their striking properties, such as color, fire, hardness and the like. Then in the chemist's laboratory synthesis was undertaken to duplicate what was found in nature. Finally, the third step of development, or improvement, was undertaken, until now in the field of corundum and spinel gems we have the synthetic sapphires, synthetic rubies and synthetic spinels, which are the same as the natural in their essential properties, and which excel the natural in variety of color. These synthetics are not imitations, but duplicates of the natural gems. Recently we hear of synthetic emeralds. The story is only started, as our research has but touched the fringes of the possible in this field. Such analysis and synthesis has greatly increased our understanding of the entire domain of jewels, natural and synthetic, and the underlying causes of their beauty, and why they are prized and sought after.

Let us see what a jewel is and what are its outstanding characteristics of beauty! Let us list these attributes as found in our gems:

(a) *Beauty of color:* This may be natural and inherent (idiochromatic) as occurs in lapis lazuli, malachite, turquoise and hematite. This type of color is based on the very nature of the mineral, and is destroyed if the composition is changed. On the other hand, there are the great majority of jewels in which their beautiful color is due to an "impurity." Here the gem is colorless when pure (allochromatic), and among this type occur many of our finest gems, as sapphire, topaz, emerald, aquamarine, amethyst and agates.

(b) *Beauty of structure:* Irregularities within the jewel are responsible for some of the most prized effects, such as inclusions, bands and fibrous arrangement.

Inclusions occurring in a systematic manner are the foundation of the rare asterisms, as seen in the star sapphire and the star ruby. When these inclusions are formed in a dendritic or tree-like manner in the agate, we call this moss agate.

Banding of color arrangement causes much of the attractiveness in agates, malachite and onyx, and is the basis of the carving into cameos and intaglios.

Play of colors is due to internal irregularities leading to light interference, and forms the soft radiance of the pearl, or the gorgeous and changing color sequences of the opal.

Chatoyance is owing to a fine fibrous structure, and is the velvety appearance seen in tiger's eye (crocidolite) and satin spar.

(c) *Beauty of luster:* This is that phenomenon of light thrown off from the surface, largely caused by brilliance of reflection and high index of refraction, and resulting in the adamantine luster of the diamonds and the resinous luster of amber.

(d) *Beauty due to fire:* The wide dispersion of light, exemplified in diamonds and zircons, causes those color flashes of clear fire that are judged by many to be one of the chief attributes of beauty of our jewels.

(e) *Beauty due to transparency:* Being able to see into the "depths" of a stone enhances its other qualities and lends to its value. We can better appreciate the beauty of transparency by considering how we avoid the opposite or a muddy stone.

(f) *Durability or hardness:* Jewels to be prized must be sufficiently hard to be durable. The extreme hardness of the diamond maintains its high worth through the years.

(g) *Rarity:* This psychological value is very real. There are still, and always will be, people who will gladly pay for rarity. The ruby commands a ready market at a hundred times the valuation of its counterpart in the synthetic field.

The *precious* stones—the emerald, ruby, sapphire, diamond and pearl, with perhaps the opal, are those that possess these various characteristics of beauty to the fullest extent; *that* is why we call them the precious stones. The semi-precious gems are less rare, or less durable, or possess in somewhat smaller degree some of the characteristics we have just enumerated.

BEAUTIFYING CONSTITUENTS

It is very striking to observe that the quality distinguishing one gem from another or of a gem itself from an otherwise simply interesting mineral, is, in most instances, caused by the presence of a small amount of some material that imparts color, or other pleasing characteristic. The few idiochromatic, or self-colored stones, are exceptions. The asterism, so highly prized in the star sapphire, is caused by minute inclusions that reflect the light in such a manner as to give this star effect. These included or color-imparting materials are rated as the minor constituents in the composition, and are often called the impurities. I myself much prefer to speak of these minor constituents which, for instance, change an otherwise almost worthless bit of beryl into that most valuable of gems, the emerald, as the *beautifying constituents*.

Thus, as we correlate the chemical structure with the pleasing characteristics that give gems their value, we find that we are interested in two ways: First, in the chemical composition of the mineral to which the gem belongs, and second, in these beautifying constituents or so-called impurities. The diamond possesses in an unexcelled degree the characteristics that we have enumerated as gem qualities. Chemically, the diamond is one form of the element carbon, but even here in very unusual instances we will find the most prized diamonds to be those which have a gorgeous color superimposed on the usual fine gem characteristics of this form of carbon. We will possess, for example, in the rare red or blue diamond, a stone with color added to the usual luster, and fire, and transparency. This color is caused by the presence of the beautifying constituent in very small amounts and of unknown composition. Certain other gems, such as azurite, lapis lazuli, malachite and turquoise, have the beautifying color actually a property of the chemical constituting the gem. But, on the other hand, the vast majority of stones owe their gem interest to the presence of a small amount of this beautifying constituent, quite apart from the main chemical compound composing the mineral background. For instance, if the pure compound which gives the fundamental properties of hardness or luster, or the like, to the sapphire, topaz, emerald or zircon were present as an absolutely chemically pure product, these stones, and many others, as you see, would be colorless, with very little character, and would lose a very large proportion of their value as precious stones. But when there appears, superimposed upon the composition of the mineral, a small amount of these beautifying constituents, we have the wonderful blue of the sapphire or the gorgeous red of the ruby or the soft brown tints of the topaz.

These beautifying constituents occur in relatively small amounts and, because of their influence in changing these minerals otherwise of little value to gems of great value, it is asserted that they create more actual worth than anything else in the world of the same weight. The beautifying constituent of the emerald is 1½ per cent. of chromium, which added to the colorless goshenite makes the emerald, and by so doing changes the almost valueless goshenite into that most valued of all gems—imparting a value of frequently more than $1,000 for each carat of emerald. At this rate the value imparted by the chromium as beautifying constituent figures out to the rate of $150,000,000 per pound of the chromium. Is it any wonder that I call these often rated impurities the beautifying constituents? Actually by making the minerals less perfect they enhance the beauty and increase the value. The imperfect becomes the more valuable! These beautifying constituents, comparatively minute in their percentage yet imparting the magnificent color to most of our gems, may be looked upon as the most interesting and indeed the romantic feature of the structure of these jewels. Our eye all along has seen this sumptuous beauty; may our mind be trained to conceive its cause!

In our study of gems we have found out much about the different ones that are pleasing to us, and we shall arrange these according to their chemical structure in a number of classes, and point out their beautifying constituents when these are known, as shown in the following sections.

ELEMENTS

In this group is the leader before all gems—the diamond. It is usually in a pure form, indeed the very purest form of carbon, and its outstanding properties of luster, hardness and fire are conferred upon it by the inherent structure of this form of carbon. Yet, even here the value is enhanced in certain very rare instances by the presence of some beautifying constituent that adds color, as when we have the rare red or other colored diamond. This gives an exceptionally pleasing combination, with color added to the diamond's usual superior qualities of brilliance, hardness and fire.

OXIDES

Silica: The common or ordinary sand of our shores falls within the classification of silica. Likewise under this heading are a great many varieties of gems, and indeed the very purest form of silica is our rock crystal, which furnishes such beautifully crystal-clear brilliant beads and ornaments. In this group, in a superlative degree, the beautifying constituents come into play, adding a broad range of color and texture to these stones.

We do not know what all these beautifying constituents are, but we have ascertained that a small amount of ferric iron present in crystal silica furnishes citrine, or, as it is generally called, false topaz, or simply topaz.[2] A little manganese gives the beautiful, soft tints of the rose quartz, and also a little iron probably furnishes the much-prized amethyst. In certain instances, inclusions add the particular beauty to the quartz, such as the opalescent appearance of milky quartz, caused by minute liquid-filled cavities, or the Venus hair stone, wherein the needle-like crystals of rutile or actinolite or even tourmaline lend interest and distinction to this special form of quartz.

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[2] This name should not be used for citrine, but only for the rare real or precious topaz.

There is a variety of quartz which lacks the clear crystalline form of our rock crystals, possessing a fibrous structure. This, in its soft gray tone, is recognized as chalcedony or, when a little ferric oxide comes in, evenly distributed as a beautifying constituent, we have the reddish carnelian; while with agate we have the same basic material, colored unevenly with this same ferric oxide, and as sardonyx we recognize a banded material with red and white layers. When manganese oxide is found in with the chalcedony in a dendritic or tree-like form, we call it moss agate.

Finally, in our silica family, when water occurs as an integral part of the gem, setting up strains and internal irregularities, we possess that most beautiful and most highly prized of all varieties of silica, the opal. If one takes such a stone and looks at it by transmitted light, there is little or no color, but the reflected rays are broken down by interference into the rainbow hues which are the glories of our opals. This same phenomenon also causes the play of color when a thin film of oil floats on water. Depending upon how the internal irregularities of the opal are arranged, we have different varieties of this lovely stone which we call by various names, such as fire opal, black opal or harlequin opal. Because these stresses sometimes exceed the natural bond or coherence of the gem, we lose an occasional fine opal by cracking. Thus does the cause of the breath-taking beauty of the opal sometimes carry also its own fragility! But this should rather lead us to prize more truly such changing and radiant colors.

Corundum: The mineral corundum in composition is aluminum oxide or alumina. A somewhat similar product is manufactured on a large scale out of bauxite or the raw material for aluminum. Corundum occurs crystalline in nature in various forms. When perfectly pure it is the white sapphire. On the other hand, when very impure, mixed with magnetic oxide or iron, we call it the abrasive, emery. When nature adds the impurities, or beautifying constituents, to the white sapphire, with discretion we may say, we get some of our most beautiful jewels. The gorgeous ruby is pure crystalline corundum, or white sapphire, carrying 1 per cent. or 2 per cent. of chromium oxide as the cause of its unusual beauty. The blue sapphire is colored with oxides of titanium and iron. The rare, but very attractive golden, or yellow sapphire owes its color to iron oxide alone, and there are many others of the so-called fancy sapphires which occur in various colors, such as violet, pink and even green.

It is here that the synthetic chemist has exercised his chief skill and knowledge, for he has taken the pure alumina and mixed with it these various beautifying constituents, and then by passing this mixture through the intense heat of the oxyhydrogen flame has made synthetic sapphires and rubies which are duplications of those found in nature. Thus does synthesis confirm analysis. Furthermore, in the controlled operations of a factory, man has made other synthetic gems, such as are not found in nature, wherein the coloring constituent is a small amount of materials, as oxides of uranium or vanadium, which give effects somewhat different from the naturally occurring materials. Man has brought the coloring constituents into the sapphire base which have never happened to come into juxtaposition in nature.

Spinels: When magnesium oxide occurs with aluminum oxide we have spinels. These resemble the corundum gems, sapphire and ruby, except that they are not quite so hard and melt a little lower. On the other hand, they give very gorgeous stones. The ruby of the Black Prince in the crown of England, one of the most famous gems in the world with a recorded history of half a thousand years behind it, is really a ruby spinel. Because of the slightly lower melting point one has been able more easily to synthesize spinels, and we find among our man-made gems many examples of the skilful use of unusual constituents to impart beauty of color to the otherwise clear and white magnesium aluminate or spinel. A fine example of this is the cobalt colored synthetic blue spinel, which has a clearer and deeper coloration than the natural blue spinel.

Chrysoberyl is a combination of beryllium oxide with aluminum oxide, and again the pure mineral is colorless. However, one of the rarest and most beautiful of all gems, the alexandrite, is chrysoberyl with the beautifying constituent believed to be chromium oxide, which causes the change in color characteristic of the alexandrite, showing green by daylight and red by artificial light. When the structure of the chrysoberyl is so arranged in fibers that a beautiful light streak appears across the mineral, we recognize this added beauty as furnishing the cat's eye, or cymophane, a highly prized gem.

Hematite: Common, ordinary iron oxide, source of so much of our steel, does occasionally carry crystals in such hard dense masses, with black metallic luster, that it has been employed for minor jewel use. Unlike the case with our other oxides, the color is due to the inherent nature of the compound, and not to a mixture with any lesser constituent. We speak of this type of coloration as being idiochromatic.

CARBONATES

With copper carbonates, malachite and azurite, the cause of green and blue color is due to the structure of the mineral and is another example of idiochromatic or self-colored gem. In other carbonates there are present beautifying constituents, or a variation in the physical structure, causing such lovely iridescence as is found in the pearl.

SILICATES

A large proportion of the ordinary rocks that make up the fundamental structure of the globe are silicates. Among some of the specialized silicates occur magnificent jewels, such as the emeralds and aquamarines, jades and zircons, topazes and tourmalines.

Beryl: Pure beryllium aluminum silicate is colorless, and this form is known as the mineral, goshenite; but when beautifying constituents are present we have the green emerald, the green-blue aquamarine, the golden beryl and the pink morganite. The emerald is our scarcest and most valuable gem, a small amount of chromium being considered to be the beautifying constituent that imparts this color so greatly desired. The scarcity of these emeralds can be comprehended when it is recognized that many of the fine emeralds are those that were found when Pizarro conquered Peru, centuries ago, and that even now the same Andean mines are supplying high-priced jewels.

Garnets: These are quite complicated silicates, embracing almost every color but blue. Some varieties of garnet when pure are colorless, as is true of the ordinary pyrope garnets employed in Bohemian jewelry. Presumably here the beautifying constituent is iron oxide.

Jade: A stone that is indeed venerated by the orientals is jade; even the names applied to the different varieties have a romantic sound, such as "mutton-fat" jade or "imperial" jade or "melting-snow-of-camphor" jade. The jades consist of the minerals jadeite and nephrite and are complicated silicates. Quite frequently ferrous iron is the beautifying constituent, imparting the soft green color so highly prized.

Zircons: Pure white zircon is incorrectly called the "mature diamond." It is that gem, next to the diamond, with the highest brilliancy and fire, due to its high index of refraction and high dispersion. But zircons are comparatively soft and should be repolished occasionally. Brown, and particularly blue zircons, are much sought after. The beautifying constituents are not recognized, but iron oxides do play a part in these splendid gems.

Topaz: Most of us think of the topaz as possessing a warm brown color, but this alumino fluosilicate when pure is colorless. It is often pale blue, wine yellow and occasionally pale red. We know very little about the coloring and beautifying constituents of this gem. The coloring matter is comparatively unstable, and pink topazes are frequently made by simply heating. However, alteration does not take place under ordinary conditions of use. Because of such change of color of the topaz we do not believe it is due to the metallic oxides, but to some colloidal constituent.

Tourmalines are borosilicates with beautifying constituents present to furnish a great variety of colors, which may be pink, rose red, green, dark blue or colorless. Sodium and lithium occur in the rose red rubellite, though there may be even here another still unknown constituent that imparts this color. If much iron is present there occurs the black non-gem variety known as schorl.

PHOSPHATES

Turquoise is another gem wherein the color is caused by the copper-bearing nature of the mineral. This color does change somewhat with the ratio of copper-iron, wherein the variance will go from blue, due to copper, to green, where ferric iron is present.

SULFATES

Satin Spar: Crystallized calcium sulfate is quite soft and it must therefore be handled carefully and polished frequently, yet the irregularities in the growth of its fibrous structure imparts that chatoyant luster to this mineral which leads to its use in such semi-precious jewels as beads, and the like, wherein the wear is not very pronounced.

We have traveled from one gem to another, and seen something of their various types of beauty—and the cause of all this! Is there not as much romance and seeming mystery in the flaming colors of an opal—caused by imperfections—yes, cracks in its structure; or in the gorgeous greenness of the emerald, resulting from the presence of but a small amount of chromium; or in the limpid magnificence of a pearl, based here also on irregularities of composition—are not all these as romantic as the conquest by the Normans or the love wanderings of Evangeline or the landing of the Pilgrims?

We now take leave of our jewels—jewels born in travail of heat, fire and stupendous forces—jewels born not in a few hours, but in the processes of the ages—jewels born in the recesses of the earth—jewels revealed only by man delving deep into the secret places of the world or by the natural disintegration of these hidden deposits by the slow action of wind and water, heat and cold.

OBITUARY

CHARLES WILLIAM WOODWORTH

CHARLES WILLIAM WOODWORTH,[1] entomologist, mathematician, physicist, chemist and inventor, was born at Champaign, Illinois, on April 8, 1865, and died at his home in Berkeley, California, on November 19, 1940. He was educated in the public schools of Illinois and was graduated from the University of Illinois with the B.S. degree in 1885 and took the M.S. degree there in 1886. During the period 1884–1886 he was assistant to S. A. Forbes, and from 1886 to 1888 and from 1900 to 1901 he studied at Harvard University under H. A. Hagen, at that time the leading entomologist of this country. In 1888 he was appointed entomologist and botanist at the Arkansas Agricultural Experiment Station. Due to successive attacks of malaria he left there in 1891 to become assistant in entomology at the University of California where he enjoyed the opportunity of founding and building up the Division of Entomology and of participating in the solution of the multitudinous entomological problems of the Agricultural Experiment Station in a region entirely new to him. Under the leadership of E. W. Hilgard and E. J. Wickson, respective deans and directors, he received much encouragement and help and rose to be assistant professor of entomology in 1891, associate professor in 1904 and professor in 1913. Upon retirement at the age of 65 in 1930 he was made emeritus professor of entomology. Also in the spring of 1900 he was appointed lecturer on comparative anatomy at the Hahnemann Hospital College of San Francisco, and later in 1906 he was a candidate for the presidency of the Mississippi State University. While on sabbatical leave in 1918 he was lecturer at the University of Nanking and honorary professor of entomology at the National Southeastern University at Nanking, China. During this year he also gave public lectures; made a mosquito survey over an area of 38 square miles and effected a practical control of the mosquitoes for the first time in the history of that city; gave courses in sericulture and greatly improved the methods of rearing and handling silkworms; taught summer classes; and organized the Experiment Station for the College of Agriculture and Forestry, which subsequently became a part of the university. He returned to China for a period of three years (1921–1924) and during that time he organized the Kiangsu Provincial Bureau of Entomology; initiated research on the biology and control of agricultural insect pests, the housefly and mosquitoes; and materially aided in the establishment and operation of several small commercial insecticide manufacturing companies of which there was a dearth in China. In the words of the president of the University of Nanking, "He served China in a magnificent way." In this period also he made a trip around the world, one purpose of which was to identify a collection of Chinese insects at the British Museum. This latter effort was prevented by the loss of the specimens through their being carelessly dropped overboard by the ship's crew. Since retiring from the University of California, he had devoted himself to an extremely varied program at home and abroad. From 1930–1932 he was chief entomologist for the California Spray Chemical Company and spent much of his time traveling in South America. He was at Rochester, New York, in 1934–1935 and there gave a series of lectures on optics to certain members of the Bausch and Lomb Optical Company.

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[1] E. J. Wickson, *Pacific Rural Press*, 102: 353 (front), portrait, 1921. E. O. Essig, "A History of Entomology," pp. 800–802, portrait, 1931.

Woodworth came to California at the time when there were many new and pressing problems in entomology and a great need for teaching, research and practical demonstrations in control. Single-handed he set out to do what a hundred or more entomologists are trying to accomplish at the present time. His powers of concentration and his industry and productiveness can be attributed to an unusually resourceful mind, a strong and healthy body and a keen interest in his work. He often toiled almost day and night to develop an idea, and he usually communicated his thoughts to others in order to gain a wider viewpoint concerning a problem. During my thirty years' association with him I never saw him angry or heard him utter an unkind word. His habits indicated a sound moral character. He traveled extensively throughout California and the United States and made a trip to Europe in 1901 in addition to the trip around the world and the one to South America I have already noted. Contacts with farmers he maintained by writing letters and answering inquiries and determining insect specimens; publishing circulars, bulletins and reports; addressing farmers' institutes and other meetings; and by farm visits; by training students in entomology; and by cooperative investigations and demonstrations relating to the control of insect pests. He had much to do with the early development of the manufacture and uses of London purple, Paris green, calcium arsenate, acid and basic lead arsenate, calcium arsenite, zinc arsenite, lime-sulfur, petroleum oil emulsions and sodium and potassium cyanide fumigation. To protect the farmers against losses due to adulteration of Paris green he proposed and drafted the first California Insecticide Law in 1906, was largely instrumental in securing its passage in 1911 and administered the law until July 1, 1923. Entomological campaigns which he conducted in California concerned the codling moth, the peach twig-borer, citrus insects, grasshoppers, citrus white fly eradication, and the proper allowances for tent leakage in HCN fumigation of citrus trees.

He was much interested in theology and belonged to the Baptist Church; in prohibition and was a delegate to one of the California state conventions; in chess, which he studied mathematically and analyzed 30,000 games; shorthand, in which he perfected an extensive new system; mathematics, concerning which he wrote on logarithms and anti-logarithms and published a booklet on "Five-place Arc Sines and Cosines for Machine Calculation Interpolating to Eight"; physics, in which optics interested him for many years and concerning which he published "Contribution to the Optics of the Microscope" in 1919 and "Microscope Theory" in 1924; and chemistry, in which he invented and patented a new process for the distillation of petroleum oils at low temperatures.

His publications in entomology are very extensive and included nearly every field; systematic and economic entomology, anatomy, physiology, toxicology, ecology, apiculture and sericulture. A few of his most outstanding works are: "A List of the Insects of California" (1903), "The Wing Veins of Insects" (1906), "Guide to California Insects" (1913) and "School of Fumigation" (1915). He was the first editor and first contributor to the University of California Publications in Entomology.

He was married to Leanora Stern in 1889, who bore him three sons, Lawrence, Harold Evans and Charles Edward, and a daughter Elizabeth, all of whom survive him. Following the death of his first wife, he was married to Bernice Christopher in 1926. The latter died in 1930.

E. O. Essig

University of California

RECENT DEATHS

Dr. Thomas Russell Wilkins, professor of physics at the University of Rochester, died suddenly on December 10 at the age of forty-nine years.

Dr. Gladwyn Kingsley Noble, curator of the departments of herpetology and experimental biology of the American Museum of Natural History, with which he had been connected since 1919, died on December 9 at the age of forty-six years.

Dr. F. W. Edwards, since 1937 deputy keeper of entomology at the British Museum (Natural History), died on November 15 at the age of fifty-one years.

Dr. Heinrich Kayser, emeritus professor of physics of the University of Bonn, known for his work in spectroscopy, died on October 14 at the age of eighty-seven years.

Nature reports the death of M. Charles Nordman, since 1920 director of the Paris Observatory, on November 15 at the age of fifty-nine years; of Professor Hans Rosenberg, an authority on astronomical photometry, formerly director of the observatory at Istanbul, aged sixty-one years.

SCIENTIFIC EVENTS

THE WAR AND THE BRITISH FAUNA[1]

It is probably still too early to judge the effects of the war upon British wild life, for it was not until the second or third years of the war of 1914–18, when the calling-up of older men had more extensively depleted the game-keeping profession, that the great increase in so-called "vermin," including rarer species like the wild cat and polecat, became of national concern; nevertheless, the present war has speeded up a great deal of this disturbance of wild life by the greater activity at home. The most noticeable effects have been an extension of the range of normally persecuted species like the carrioncrow, fox, otter, kestrel, little owl and sparrowhawk and this may be followed by a slower extension of species like the badger and raven. The use of sand-dunes and lonely islands in the coastal defenses and of rural parks for training the army has considerably disturbed the nesting haunts or "sanctuaries" of uncommon species, particularly birds, more so than the building of factories in rural areas, and this may have a permanent effect in further reducing the nesting population of terns, waterfowls and waders.

On the other hand, the breaking up of estates and game preservation is furthering the extension of the little owl and the grey squirrel in the north of England. As in 1914–18, the rumor has gained popularity that warfare on the Continent has sent rarer Continental birds to nest in England, notably the avocet in Essex, but it is unlikely that the campaign abroad had any effect upon the British avi-fauna. Pollution of rivers has again arisen, notably on the Severn, Bristol Avon, and the Derbyshire Derwent, with considerable loss of fish life. It yet remains to be seen if the rosebay willow-herb will emulate the story of the London rocket in spreading over ruined buildings in London and other cities; that the poppy will recolonize the Flanders area in its former abundance is very likely, for the destruction of buildings has again made the soil highly calcareous.

THE HERBARIUM OF THE NEW YORK BOTANICAL GARDEN

The herbarium of the New York Botanical Garden, into which the two millionth specimen was incorporated at a special ceremony on the afternoon of December 11, is the largest herbarium in the United States being operated under a single head. The ceremony, during which Joseph R. Swan, president of the Board of Managers of the garden, placed the two millionth specimen in its niche in the herbarium, was preceded by a program beginning at 3:30 P.M. in the Museum Building, and was followed at 4:30 by tea served in the new Members' Room.

In his opening remarks, Dr. William J. Robbins, director, briefly described the research work being done at the New York Botanical Garden through the aid of the herbarium. In addition to many thousands of specimens identified every year as a service to the public, this work included special studies of many families of plants.

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[1] From *Nature*.

Other speakers were: Dr. H. A. Gleason, assistant director and head curator, on "Important Publications from the Garden Herbarium"; Dr. H. N. Moldenke, associate curator, on "Important Collections in the Herbarium"; E. J. Alexander, assistant curator, on the "Relation of the Herbarium to Horticultural Progress"; Dr. W. H. Camp, assistant curator, on "The Herbarium in Scientific Research," and Dr. J. H. Barnhart, on "The History of the Garden Herbarium." In his address Dr. Barnhart called attention to the circumstance that several parts of the herbarium had received special names in commemoration of former members of the staff. The first to be so honored was Professor L. N. Underwood, who died in January, 1907. A year later the entire fern collection was officially designated the "Underwood Fern Herbarium," and a bronze tablet was installed recording the fact. In 1934, Mrs. Britton's work was commemorated in the naming of the moss collection the "Elizabeth Gertrude Britton Moss Herbarium," and in the following year the general herbarium was designated the "Britton Herbarium," in memory of the first director of the garden.

While slightly exceeded by the United States National Herbarium in Washington in its specimens of flowering plants, the herbarium of the New York Botanical Garden ranks first in the country in plants of certain regions; for example, the southeastern states, the West Indies and Bolivia, and in the flora of Asia. It also stands first in mosses and in myxomycetes (a low order of plants somewhat akin to the fungi), and ranks among the first in its collections of algae and fungi.

Altogether, the herbarium contains 1,388,833 specimens of flowering plants and ferns; 177,000 mosses; 61,400 liverworts; 87,500 algae, and nearly 305,000 fungi, including lichens, making a total to date of 2,019,000 specimens. The two millionth to be accessioned was a specimen of a rare clematis collected in Kentucky last summer by Dr. Gleason, who with John Dwyer, a graduate student from Fordham, was making an extensive collecting trip through the eastern and central states.

Special studies being carried out at the garden by members of the staff are:

Dr. H. A. Gleason, head curator, is working in the Melastomes, an American group of nearly 4,000 species, a number of which are in greenhouse cultivation.

Dr. H. N. Moldenke, associate curator, is studying the Verbena and Black Mangrove families throughout the world, and is also doing research on the plants of the Bible, the flora of the Watchung Mountains of New Jersey, and on certain arrow poisons used in South America.

Dr. W. H. Camp, assistant curator, is working on the Blueberries and their relatives from the viewpoint of a botanist, and is also at present investigating the beeches, making special studies of the flowers and of the remnants of these trees from past geological ages.

E. J. Alexander, assistant curator, works on the flora of the Southern States, on the Cacti and other types of succulent plants—especially those which the Garden has on display in the conservatories. He is responsible for the correct naming of all the plants cultivated at the New York Botanical Garden.

B. A. Krukoff, honorary curator of economic plants, devotes his energies to plants of medicinal importance.

A number of graduate and fellowship students are also working on special plant problems at the Botanical Garden.

FIFTIETH ANNIVERSARY OF THE INSTITUTE OF EXPERIMENTAL MEDICINE IN LENINGRAD

DR. W. N. BOLDYREFF, now of Tucson, Arizona, writes to SCIENCE calling attention to the fiftieth anniversary of the Institute of Experimental Medicine which was founded at St. Petersburg by Prince A. P. Oldenburg in December, 1890, with the cooperation and advice of Louis Pasteur.

Dr. Boldyreff worked at the institute for many years. From the first young scientific men of promise were made directors of the separate laboratories. The chiefs of departments included I. P. Pavlov, physiology; M. V. Nezki (a Pole), biochemistry; S. N. Vinogradski (now vice-director of Pasteur Institute at Paris), microbiology; N. V. Uskov, pathological anatomy; S. M. Loukianov, pathology; H. J. Gelman, veterinary medicine; V. A. Kraiushkin (of the Pasteur vaccination against hydrophobia), and N. C. Shulz, practical bacteriology. Dr. M. V. Nezki had been a professor in the University of Bern, Switzerland, and Dr. S. N. Vinogradski was an associate of Louis Pasteur and had discovered the microbe acidifying ammoniac in the ground.

The institution worked not only for purely scientific purposes, but also for the application of new discoveries to the needs of every-day life such as the fight against different infectious diseases, the invention of better methods of disinfection, the elaboration of new drugs and methods of treatment of disease, etc. It was fully equipped. Much money was given for experimental work and for the salaries of investigators and other employees. The director of the institute (the first director was Dr. E. F. Sperk, the specialist in syphilology) and all assistants had furnished quarters in the building, situated in a beautiful park on the edge of the city. There was established also a cheap but excellent restaurant for employees.

The institute was attended by many young doctors and other scientific workers. Papers were published in its own journal, *Archives des Sciences Biologiques* both in Russian and French, and in the best foreign journals.

Here Pavlov did all his scientific work and completed classical experiments on digestion and conditioned reflexes. Many well-known scientific men graduated from the institution and many papers were published, some of them devoted to the discoveries made in the institute. A few of those who participated in its foundation are still living. Among these are Dr. S. N. Vinogradski (Paris) and Dr. V. G. Ushakov (Leningrad), who was at that time and later secretary of the council of the institute.

CONFERENCE IN HONOR OF LETA S. HOLLINGWORTH

A CONFERENCE on Education for the Gifted in honor of the late Professor Leta S. Hollingworth was held at Teachers College, Columbia University, on December 13 and 14. Dr. William F. Russell, dean of Teachers College, was honorary chairman of the conference and Dr. Herbert B. Bruner, professor of education, was chairman. The introduction to the printed program says: "This Conference on Education for the Gifted is held in honor of Leta S. Hollingworth, professor of education in Teachers College, whose untimely death last year brought to a close a brilliant career. Our discussions here are designed to promote increased activity in the discovery and education of the gifted—the task to which she so earnestly devoted herself and which she considered of paramount importance in our national life."

Speakers and their subjects at the opening meeting, over which Professor Lyman Bryson presided, included Dr. Nicholas Murray Butler, president of Columbia University, whose address was entitled "The Basic Problem," and Dean William F. Russell, who spoke on "The Importance of Social Capillarity." They were followed by a presentation of "Major Problems Regarding the Gifted"—The Place of the Gifted in Modern Life. In this discussion Lammot du Pont spoke from the viewpoint of industry; Spencer Miller, Jr., from the viewpoint of labor, and Bishop Francis J. McConnell, from the viewpoint of the ministry. Other speakers were Robert L. Thorndike, associate professor of education; Herbert B. Bruner, professor of education, and David E. Weglein, superintendent of schools, Baltimore, Md.

Friday afternoon was devoted to seminars, of which there were thirteen as follows: Who is the Gifted Child?; What Special Problems Are Encountered by the School Administrator in Providing for the Education of the Gifted and How May These Problems Be Solved?; What Is the Place of the Gifted in Modern Life?; Gifted Children; their Educational Needs; Education of Gifted Pupils in Secondary Schools; How Can We Best Educate Teachers for Work with Gifted Children?; What Are the Physical and Mental Health Problems of the Gifted and How Can They Best Be Met?; Home Guidance of the Gifted Child; How Can We Release the Creative Energies and Develop the Creative Capacities of the Talented Gifted Child?; Research Problems in the Study of Gifted Children; How Do the Intellectually Gifted Evaluate Their Own Educational Experiences?; What Provision Should Be Made for the Education of Gifted Persons at the College Level?; How Should a School Be Organized to Provide for the Most Effective Education of the Gifted?

At the evening session on Friday, presided over by Dr. Arthur I. Gates, professor of education, Professor Rudolph Pintner gave an address on "Superior Ability," and Dr. Edward L. Thorndike, professor emeritus, spoke on "Gifted Children in Cities and Towns."

There was a display of books and miscellaneous work of gifted children from various schools and of testing materials and cumulative records, and demonstrations of tests on children of superior intelligence and a presentation of motion pictures taken by Dr. Hollingworth, showing the work in the Speyer School.

THE JOSIAH WILLARD GIBBS LECTURES OF THE AMERICAN MATHEMATICAL SOCIETY

AT the meeting of the American Mathematical Society held at Vassar College in September, 1923, a resolution was adopted sanctioning the establishment of an honorary lectureship to be known as the Josiah Willard Gibbs Lectureship. The first lecture given under these auspices was on February 29, 1924, by Professor M. I. Pupin, of Columbia University, on the subject, "Coordination." Professor Veblen was then president of the society, and the purpose of the lectureship can perhaps best be summed up by quoting from his remarks in introducing the speaker.

> In instituting the Willard Gibbs Lectures, the American Mathematical Society has recognized the dual character of mathematics. On the one hand, mathematics is one of the essential emanations of the human spirit,—a thing to be valued in and for itself, like art or poetry. Gibbs made notable contributions to this side of mathematics in his work on vector analysis and multiple algebras.
>
> On the other hand, mathematics is the handmaiden and helper of the other sciences, both in their most abstract generalizations and in their most concrete applications to industry. In this field Gibbs may be justly described as transcendental,—even if we think only of his work in thermodynamics. His paper "On the Equilibrium of Heterogeneous Substances" is one of the foundation stones of physical chemistry.
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> It is hoped that the Willard Gibbs Lectures will remind

the mathematicians of something that we fear they sometimes forget,—the existence of an outside world. It is equally hoped that they will remind the outside world that mathematics is a going concern,—not a pedantic exercise for the torment of school boys, but a living organism growing larger and stronger each year.

Since this first lecture by Professor Pupin, the following scientific men have accepted the invitation of the society to speak under the auspices of this lectureship:

Robert Henderson: Life Insurance as a Social Service and as a Mathematical Problem.
James Pierpont: Some Modern Views of Space.
H. B. Williams: Mathematics and the Biological Sciences.
E. W. Brown: Resonance in the Solar System.
G. H. Hardy: An Introduction to the Theory of Numbers.
Irving Fisher: The Application of Mathematics to the Social Sciences.
E. B. Wilson: Reminiscences of Gibbs as a Student and Colleague.
P. W. Bridgman: Statistical Mechanics and the Second Law of Thermodynamics.
R. C. Tolman: Thermodynamics and Relativity.
Albert Einstein: An Elementary Proof Concerning the Equivalence of Mass and Energy.
Vannevar Bush: Instrumental Analysis.
H. N. Russell: Model Stars.
C. A. Kraus: The Present Status of the Theory of Electrolytes.
Theodore von Kármán: The Engineer Grappling with Non-linear Problems.

The next lecture will be given by Professor Sewall Wright, of the department of biology of the University of Chicago, at the time of the summer meeting of the society and the Mathematical Association of America to be held at the University of Chicago next September.

SCIENTIFIC NOTES AND NEWS

AT the annual dinner of the Geological Society of America to be held in Austin, Texas, on December 27, the Penrose Medal will be presented to Dr. N. H. Darton, consulting geologist, who from 1886 until his retirement in 1936 was geologist of the U. S. Geological Survey.

DR. T. HARPER GOODSPEED, professor of botany and director of the botanical gardens of the University of California, has been elected a foreign correspondent of the Argentine Scientific Society.

G. WALTER DITTMAR, professor emeritus of the College of Dentistry of the University of Illinois, will be the guest of honor at a banquet to be held at the Lake Shore Club of Chicago on February 15. Dr. Dittmar is a past president of the American Dental Association. He retired from active teaching last September.

THE honorary fellowship of the Canadian Public Health Association has been conferred on Dr. E. W. Montgomery, emeritus professor of medicine at the University of Manitoba, formerly Minister of Health and Public Welfare of the Province of Manitoba, and on Dr. J. M. Ulrich, Minister of Public Health and Provincial Secretary of the Province of Saskatchewan.

DR. RICHARD S. WEISS, professor of clinical dermatology of the School of Medicine of Washington University, St. Louis, was elected at the Chicago meeting president of the American Academy of Dermatology and Syphilology.

AT the thirty-sixth annual meeting of the American Society of Tropical Medicine, which was held in Louisville, Ky., from November 12 to 15, in conjunction with the annual meeting of the Southern Medical Association, the following officers were elected: *President,* Thomas T. Mackie, New York City; *President-elect,* Ernest Carroll Faust, New Orleans, Louisiana; *Vice-president,* Fred L. Soper, Rio de Janeiro, Brazil; *Secretary-Treasurer* for three years, E. Harold Hinman, Wilson Dam, Ala.; *Editor* for three years, Colonel Charles F. Craig, San Antonio, Texas; *Councilors* for four years, R. E. Dyer, Washington, D. C., and T. J. LeBlanc, Cincinnati; *Member of the editorial board* for five years, John F. Kessel, Los Angeles, Calif.

R. E. ZIMMERMAN, vice-president of the United States Steel Corporation, was elected president of the American Standards Association at the annual luncheon meeting held on December 11 at the Hotel Astor, New York City. Mr. Zimmerman has served as vice-president of the association since 1938, and has been a member of the Board of Directors since 1937, when he was nominated for membership by the American Iron and Steel Institute. He will succeed Edmund A. Prentis, of the firm of Spencer, White and Prentis, who has served as president of the association for the past two years. R. P. Anderson, of the American Petroleum Institute, was reelected chairman of the council, which is in charge of the technical work of the association.

DR. JAMES L. BRAKEFIELD, professor of biology and head of the department at Howard College, will complete his second term as president of the Alabama Tuberculosis Association at the annual meeting to be held on January 23. During Dr. Brakefield's administration local county and municipal organizations for the study and control of tuberculosis have been formed in more than sixty of the sixty-seven counties of Alabama.

Dr. Eric T. B. Gross, formerly lecturer in the School of Electrical Engineering of the Institute of Technology in Vienna and head of the engineering division of the Central Station Department of the Union Electric and Manufacturing Company in Vienna, has been appointed Westinghouse research associate in the School of Electrical Engineering at Cornell University.

Dr. W. L. H. Duckworth, master of Jesus College, Cambridge, has retired from the readership in human anatomy after twenty years in that office; Dr. G. S. Graham-Smith has retired from the readership in preventive medicine.

Dr. John B. Baker, for the past six years assistant professor of mechanical engineering at the Drexel Institute of Technology, Philadelphia, has a year's leave of absence to become instructor for the Engineer Organized Reserves. His headquarters will be at the First Military Area, Customs House, Philadelphia, where he will be in charge of the training, assignments, transfer and procurement of engineer reserve officers.

The Rockefeller Foundation has made a grant to aid a five-year program of research in the genetics of plant growth under the direction of Dr. Donald F. Jones, geneticist at the Agricultural Experiment Station at New Haven.

The Committee on Scientific Research of the American Medical Association has awarded to Dr. Arthur C. Allen, of the Mount Sinai Hospital, New York City, a grant for the study of the effect of certain drugs on the vegetations of experimental bacterial endocarditis.

The London *Times* reports that Sir George Chrystal, secretary of the British Ministry of Health, is retiring on reaching the age limit. Sir John Maude, deputy-secretary, has been appointed to succeed him, and A. N. Rucker has been made deputy-secretary. Sir Arthur MacNalty, chief medical officer of the Ministry of Health and of the Board of Education, also is retiring on reaching the age limit. The Minister of Health and the president of the Board of Education have respectively appointed Sir Wilson Jameson to be chief medical officer of the Ministry of the board. Sir Wilson Jameson is relinquishing the post of medical officer to the Secretary of State for the Colonies. He is also relinquishing the post of dean of the London School of Hygiene and Tropical Medicine and professor of public health in the University of London.

The British Ministry of Food announces that the Flour (Vitaminisation) Advisory Committee, which was recently appointed, will have the assistance in its official capacities of Professor D. S. M. Watson, of the Scientific Sub-Committee of the Food Policy Committee of the Cabinet; of P. N. R. Butcher, of the Ministry of Health, and of the following officers of the Ministry of Food: Sir Norman Vernon, director of flour milling; Professor J. C. Drummond, scientific adviser; Dr. T. Moran, deputy scientific adviser, and Mr. J. H. Pillman, manager for imported flour.

Dr. Walter L. Bierring, president, and Dr. J. J. Moore, secretary, of the Alpha Omega Alpha honorary medical fraternity, participated in the installation of a chapter of this fraternity at the Medical College of Virginia on December 4.

Dr. Noel Paul Hudson, professor of bacteriology at the Ohio State University College of Medicine, has a year's leave of absence to join the health commission of the Rockefeller Foundation working in France. With other members of the commission Dr. Hudson left late in October. He had previously served with the International Health Division of the Rockefeller Foundation.

Dr. Peyton Rous, a member of the Rockefeller Institute for Medical Research, on December 6 and 9 delivered the William Henry Welch Lectures at the Blumenthal Auditorium of the Mount Sinai Hospital of New York.

Dr. Selig Hecht, professor of biophysics at Columbia University, lectured on December 6 at a meeting of the Rochester Chapter of Sigma Xi at the University of Rochester on "The Chemistry of Vision."

Dr. Firman E. Bear, head of the department of soils and crops of Rutgers University, spoke at the New York Botanical Garden on December 10 on "Plants and the Course of Civilization."

James Stokley, editor in astronomy for Science Service, lectured at the Cosmos Club, Washington, D. C., on December 9. The title of his lecture was "Roaming the Heavens."

The Huxley Memorial Lecture of the Royal Anthropological Institute, London, was delivered by H. J. E. Peake on November 26. He spoke on "The Study of Prehistoric Times."

At the December meeting of the American Academy of Arts and Sciences, three papers were presented from the Harvard Astronomical Observatory. Fletcher G. Watson spoke on "The Approaching Comet"; James G. Baker on "Trends in Astronomical Optics," and Donald H. Menzel on "Motions in the Solar Atmosphere," showing moving pictures of the solar prominences as photographed on the Pic du Midi by Dr. Bernard Lyot, of Paris.

At the annual meeting of the Geological Society of America, to be held at Austin, Texas, on December 26, 27 and 28, the address of the retiring president, Dr. Eliot Blackwelder, professor and head of the department of geology at Stanford University, will be given on the evening of December 26, the title being "Science and Human Prospects." Meeting with the Geological Society of America are the Paleontological Society and the Mineralogical Society of America. The address of the retiring president of the Paleontological Society will be given on the morning of December 26, by Dr. Carl O. Dunbar, professor of paleontology and stratigraphy and curator of the Peabody Museum of Yale University, the title of his address being "The Permian Faunas: A study in Facies." The address of the retiring president of the Mineralogical Society of America by Dr. W. F. Foshag, curator of the U. S. National Museum, will be given on the morning of December 27 on "Problems in the Study of Meteorites."

The Academy Conference of the American Association for the Advancement of Science will meet at the Bellevue-Stratford Hotel, Philadelphia, at 3 P.M. on December 27. The conference is composed of (a) the representatives of the affiliated academies of science (one from each academy) in the Council of the Association and (b) the members of the Executive Committee. The Academy Conference welcomes the attendance of those interested in the relations between the academies and the association. The program will consist of two principal papers which will be followed by informal discussion: "Methods of Bringing the Academy into Closer Relationships with Other Organizations," by Dr. P. D. Strausbaugh, West Virginia Academy of Science, and "Long Range Planning for the State Academies of Science," by Dr. W. F. Rudd, Virginia Academy of Science. The conference will be followed at 6 P.M. by the annual academy dinner to the members of the conference.

The council of Scientific Societies of Western New York held its first annual scientific symposium on November 23. A large number of technical papers were presented at the afternoon sessions, and in the evening Dr. C. J. Phillips, of the Corning Glass Company, gave a lecture with demonstrations entitled "Modern Miracles in Glass." The purpose of the council is stated to be "To afford scientists in Western New York an opportunity to meet one another, to publicly present the results of their original research and to permanently record these results through publication." Officers of the council are *President,* Irving G. Reimann; *First Vice-president,* A. H. Bennett; *Second Vice-president,* Oscar W. Richards; *Secretary-treasurer,* Harold D. Mitchell. Member organizations are the Amateur Telescope Makers and Observers; the Aquarium, Botanical, Conchological, Geological, Microscopical and Mycological and Bryological Sections of the Buffalo Society of Natural Sciences; the Buffalo Ornithological Society; the Buffalo Section of the American Association of Civil Engineers; the Buffalo Zoo; Canisius College Chemistry, Mendel, Strohaver Science, High-school Science, Roosevelt Field, Allegany Field and Trail, and Science Museum Photographic Clubs; the Mathieson Alkali Works, Inc., Niagara Falls, N. Y.; the Nature Sanctuary Society of Western New York; Pratt and Lambert, Inc., and the Spencer Lens Company.

The Plant Hormone Laboratory at Connecticut College, New London, will be open from June 23 to August 16, 1941, to adequately prepared graduate students and others wishing to carry on plant hormone research. Special arrangements may be made for shorter periods of investigation. The summer program will consist of laboratory research and seminars. Dr. G. S. Avery, Jr., Dr. J. Berger, biochemist, and other members of the staff will be available as consultants. Board and lodging may be obtained at the College Inn, located nearby. Several fellowships of $100 to $150 each are available, and investigators holding these fellowships will not be required to pay the $15 laboratory fee. Application blanks and further information may be obtained by addressing Professor George S. Avery, Jr., of the department of botany. Wherever possible a preliminary plan for the proposed summer's work should be submitted.

The Donald R. Dickey Collection and Library of Vertebrate Zoology, valued at more than $100,000, have been given by Mrs. Florence V. V. Dickey, of Ojai, Calif., to the University of California at Los Angeles. The collection contains more than 50,000 specimens of birds and mammals, a library of approximately 10,000 volumes, a small bird egg collection, a photographic collection and miscellaneous items.

DISCUSSION

THE SLEEP OF CANARIES

These canaries live uncaged in the laboratory, range in age from six months to nineteen years, and I have considerable opportunity to watch their sleep. Some sleep night after night on the same spot. This spot may be very precise. A blind male during a year and a half roosted seventeen inches from the end of a cabinet, to reach which he had to fly through a fairly encumbered 20 × 20 room, and accomplished this usually without mishap. He would not land exactly on the spot, but often surprisingly near, then carefully edge toward it, seem restless till he had arrived. When such a spot has been held a long time, in the instance of one bird for seven years, usurpers promptly are driven off, and you have the feeling that "right" weights the contest, so that a larger bird may appear not to have the "courage" of its full strength. The most remarkable example of insistence on a place began with a female who all her life occupied the transom rod over the laboratory door, had that rod taken by her mate on the night of her death, and though the rod has since been occupied by three birds, the occupant each time was of the same blood line. There is, on the contrary, the rarer individual who changes place as the season changes. An elderly female in the spring of the year sleeps on a high perch where most of the birds sleep, in early summer sleeps in the path of a draft from the door, on the hottest summer nights sleeps directly in an open screened window, in autumn moves back to the high perch, and with the coming of winter chooses a branch of a dead tree that stands close by the laboratory radiator.

The mating season here is roughly from February to June. During it the birds are apt to go straight from their activity to their roosts, but the rest of the year, especially on hot days, there will be one or more preliminary gatherings that include sometimes every bird. A gathering may last as long as twenty minutes. The birds stand near together, one preens its feathers, one pecks, one pipes, several may fight, there may be some changing of places, or two may let their bills just touch and hold their bodies as quiet as statues. Blood relations are apt to keep close—the crested, the cinnamon, the striped, the white. Between gatherings there may be eating. What breaks up a gathering is usually some small disturbance that excites one bird to fly, the others following, all presently grouped in a new place. Where and in what number they gathered you can tell afterward by the solid drippings, like milestones.

The birds sleep in one of four general positions. In the first position, either the right or the left leg is drawn up, usually the same leg night after night, the bill and face tucked under the blanket of feathers at the top of the wing. I have known a winter night when every bird slept so. In the second position, the head is not turned round, merely drawn in midway between the two wings, so that the bird looks hunchbacked, never many birds sleeping in that position, and it is more apt to occur where the perch is low and when there is restlessness in the environment. In the third position, and this is strangest, the neck is freely extended and so relaxed that the weight of the head drops it, either repeatedly like a dozing man's in a streetcar, or slowly till the bill rests on the perch, or sinks even lower, both feet then down—this an infrequent position except on hot nights when it may be more comfortable to have the head and neck uncovered, or in old and frail birds who may sleep that way because it takes strength to twist around the heavy head and tuck it under. In the fourth position the bird sleeps resting on its abdomen, the breathing then heaving the body, the position usually meaning bad heart or bad feet.

The act of falling asleep occurs in one of two ways. In the first the bird turns its head, closes its eyes, immediately or after a brief delay tucks its face and bill under the feathers. In the second it holds the head and body utterly still, the eyes wide open, the left fixed apparently on one point in space, the right on another, staring, till abruptly the eyes close and the bird falls asleep, or till the bird rouses, shakes itself and tucks under its head. The staring is noteworthy. It may last a long time. I have seen as many as six birds at various angles, close together, the whole group not by the slightest change the group shape in more than an hour, like an exemplary congregation in a church. An occasional bird apparently sleeps with its eyes open, for I have repeatedly moved my finger the whole way up to one and it did not start off.

Sleep is no more an undisturbed process with canaries than with us. There are light sleepers, heavy sleepers, one who never stirs, several who fall off their perches, one who falls off every night—resumes its sleep right on the spot where it fell. Often a bird wakes just enough to defecate. A certain big Norwich slept straight through the Toscanini concerts coming over the radio on Saturday nights, and in the mating season the tired females also slept through the concerts, but, except for these, everywhere in the nearly dark heights of the laboratory you saw the wide-awake listening heads. The birds sleep commonly with their backs to where the morning light will enter. Most are roused by a flash lamp even when their heads are tucked in. The way an individual may move in its sleep, or the way it may occasionally "mutter" in the middle of the night, suggests that its tiny brain, like ours, may be working when it should be at rest.

GUSTAV ECKSTEIN

UNIVERSITY OF CINCINNATI

TWO FACTORS OF POSSIBLE IMPORTANCE IN RELATION TO THE ETIOLOGY AND TREATMENT OF DENTAL CARIES AND OTHER DENTAL DISEASES

IT has long been known that some of the bacteria which grow on tooth surfaces have the power to ferment carbohydrates to acids which decalcify teeth and thus cause dental caries, or tooth decay.[1] A rapid fall in the pH of bacterial "Plaques" growing on tooth surfaces to as low as 4.1 has been found to occur following the ingestion of certain carbohydrates.[3] However, the pH of these "plaques" was found to rise to normal (6.0 to 7.0) within 20 to 60 minutes. Previously, the saliva has been thought to neutralize the acid "plaques" on tooth surfaces by virtue of the buffers it contains when secreted from the salivary glands.

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[1] W. D. Miller, ''Microorganisms of the Human Mouth.'' Philadelphia. S. S. White Dental Manufacturing Company, 1890.

Now, however, it has been discovered that in addition to the secreted buffers, the urea in saliva is converted to ammonium carbonate, locally on the tooth surface by the action of certain urease-containing bacteria (such as staphylococcus albus and aureus) which grow on the tooth surface in the bacterial "plaque." This ammonium carbonate neutralizes some of the acids which might otherwise produce caries activity. The urease is present in the bacteria as an endo-enzyme, and is not dissolved in the saliva. Some mouth bacteria, such as certain strains of lactobacilli, have been found to contain no appreciable urease; thus these bacteria not only increase caries activity by the fermentation of carbohydrates to lactic acid, but they also fail to retard caries activity by the conversion of urea to ammonium carbonate.

The pH of bacterial material on tooth surfaces and in cavities has been found to rise as high as 8.5 following rinsing the mouth with a carbamide (synthetic urea) solution. Calcium phosphate tends to be deposited on the tooth from the saliva instead of being dissolved from the tooth at this pH (8.5). Solutions of carbamide, used in conjunction with a tooth brush, have been found to be effective in cleaning teeth, and clinical observations have indicated that the treatment may be of value in some cases of gingivitis and pyorrhea.

Long-term studies of patients with caries and other dental diseases are now being conducted (1) using compounds containing carbamide as a dentifrice or mouth wash; (2) by inoculating the mouth with nonpathogenic urease-containing bacteria; and (3) by a combination of the two agents. These studies promise to shed new light on the causation and prevention of caries and to furnish a new treatment for gingival and periodontal diseases.

Robert M. Stephan

College of Dentistry,
University of Illinois

SIGNIFICANCE OF DISSEMINATED METALLIC SULPHIDES IN SEDIMENTARY ROCKS

In a recent issue of Science (September 20, 1940) Karl Ver Steeg refers to the presence of small amounts of sphalerite and galena in Mississippian and Pennsylvanian strata of Ohio and suggests that "these occurrences may have some value to students interested in the theories of the origin of sphalerite and galena ores such as those of the upper Mississippi Valley."

In an article entitled "The Geodes of the Keokuk Beds," published in 1916,[1] the writer pointed out the existence of sphalerite, chalcopyrite and even of millerite (NiS) in geodes at certain stratigraphic horizons of Mississippian age in southeastern Iowa and adjacent areas in Illinois and Missouri. The text contains the statement that the occurrences "promise to throw some light upon the origin of more important deposits of these minerals in sedimentary rocks showing no signs of igneous influence."

This note is not intended to detract from Ver Steeg's contribution but rather to supplement his remarks and to call attention again to the possible significance of such information in connection with the problem of origin of the Mississippi Valley lead and zinc ores.

F. M. Van Tuyl

Colorado School of Mines

VITAMIN STUDY AT THE UNIVERSITY OF TEXAS

Through the generosity of the Clayton Foundation of Houston, we have recently been able to expand our research program under the designation of the Biochemical Institute. Work already under way is being supported by the Rockefeller Foundation and the University of Texas.

Members of our research staff have pioneered in the publication of microbiological methods for the determination of riboflavin, pantothenic acid and biotin (vitamin H). Alternate methods for these and similar assay methods for other vitamins have already been devised or are in process of development.

In the expanded program it is planned, in addition to continuing investigations in progress, to apply these methods to the study and assay of animal tissues of numerous types, including embryonic tissues and tumors. The relationship of these results to the problems of metabolism will doubtless be complicated, and we do not believe anything short of a thorough study can yield results which are significant and capable of interpretation. We are fortunate in being in a position to carry out such an extended study.

Recently added members of the full-time staff include Dr. Alfred Taylor, research biologist; Dr. Maxwell A. Pollack, research chemist; Misses Ernestine Quarles, Margaret Jane Hofer and Juanita Thacker, technical assistants. Additional appointments will be made as the work progresses.

Roger J. Williams

University of Texas

THE QUININE INDUSTRY

Since the invasion of Holland on May 10, there have been persistent rumors of Nazi attempts to interfere with the Dutch quinine industry. The actual facts appear to warrant the following statement.

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[3] Robert M. Stephan, *Jour. Am. Dental Asn.*, Vol. 27, pp. 718–726, May, 1940.

[1] *Am. Jour. Sci.*, (4) 42: 34–42, 1916.

Heretofore Amsterdam has been the headquarters of an industry which has assured the supply of this worldwide remedy for malaria. By royal decree the management of this quinine industry was transferred to Bandoeng, Java, on May 14, 1940.

We have been warned, although the warning was scarcely necessary, to have no communication with our former associates in Amsterdam for fear such correspondence might be diverted to Nazi ends.

Java is now the center of the world's quinine industry, where ample production is assured of both cinchona bark and manufactured quinine. The latter is produced at the Bandoengsche Kininefabriek, the largest quinine factory in existence. There is thus no danger of a quinine shortage anywhere in the world.

The quinine industry, now centralized in the Netherlands East Indies, is completely Dutch and completely determined that Holland's plight shall not be turned to Nazi advantage. That attitude also actuates those connected either with the sale of Dutch quinine here or with the research and educational program of that industry.

NORMAN TAYLOR,
Director

CINCHONA PRODUCTS INSTITUTE, INC.,
NEW YORK, N. Y.

SCIENTIFIC BOOKS

REGIONAL PHYSIOGRAPHY

The Physiographic Provinces of North America. By WALLACE W. ATWOOD. xvi + 536 pp. 281 figures with large-scale map of the land forms of the United States. Boston: Ginn and Company. 1940. $4.80.

THE National Geographic Society in 1895 published ten Monographs by Powell (3), Shaler, Russell, Willis, Hayes, Diller, Davis and Gilbert. One year later these were bound together and published by the American Book Company under the title "The Physiography of the United States." In 1898, Ginn and Company published "Physical Geography," an elementary text by William Morris Davis. Thus was launched the modern science of geomorphology and of the regional study of the physiography of the United States.

Davis's "Physical Geography" was written with the belief that the work of rivers and streams could be taught effectively to students in elementary grades. His book had wide popularity, but later texts were so elaborated that they could be taught adequately only by specially trained teachers. This fact and the competition of general science has lost to physiography a distinct field in elementary education. As a separate science it finds but a precarious footing at the university level.

However, the interest in regional physiography has grown through the years and a number of college teachers have prepared notes for courses in this field. A recent count showed that thirty-seven universities list such regional studies, although there is no general agreement as to just what should be covered or where the course should be placed, either by the geologist or the geographer.

Bowman's fine text, "Forest Physiography," 1911, was written to serve as a background for Yale students in forestry. N. M. Fenneman's classic report to the Association of American Geographers, "Physiographic Divisions of the United States," appeared in final form in 1928. His "Physiography of the Western United States," 1931, and "Physiography of the Eastern United States," 1938, both volumes technical and encyclopedic in character, are indispensable for advanced and graduate work. Loomis's brief but interesting elementary text, "Physiography of the United States," was published in 1937. Thus the scope and field of service for any new text in regional physiography becomes a matter of concern, since its wide use will type the training of geologists and geographers.

Dr. Atwood's new text, "The Physiographic Provinces of North America," 1940, is the embodiment of his favorite course as a teacher of physiography in Chicago, Harvard and Clark Universities, and he has brought to the volume his genius for making teaching books, so often shown in the field of geography. Ginn and Company has turned out a fine example of book making. The volume has a color plate and colored maps and in a pocket a large-scale (25 × 40 inches) map of land forms of the United States by Erwin Raisz.

The text assumes an elementary knowledge of geology as a prerequisite, but it is not overburdened with technical terms. It presents the physiographic provinces of North America as the broad basic background for further scientific studies either in geography or geology. It will be read with interest by all who wish to understand the influence of the physical environment upon the history, life and development of the people of North America.

Beginning with a discussion of the regional idea in geography, the chapters follow consecutively and from east to west: the Atlantic and Gulf Coastal Plain; the Appalachian Highlands, New England, Acadian and Southwestern Divisions; The Laurentian Upland; The Central Lowlands; Interior Highlands; Great Plains; Rocky Mountains; Cordilleran Plateaus; and Pacific

Borderlands. A significant list of topographic maps to be consulted is placed at the end of each chapter, together with selected references for additional reading. A laboratory manual to accompany the volume is in preparation.

As would be expected from Dr. Atwood's long study of the region, one of the most important chapters of the book is that on the Rocky Mountains. Here he presents again his belief in the essential unity and late development of the "Rocky Mountain peneplain." While rightly emphasizing the opportunities for the superimposition of rivers from plains of basin filling, as an origin for many canyons in the Rockies, he does not exclude the older idea of antecedent streams for some of the gorges.

The volume is a modernized text in which the landscape is often described as seen from the air, and it is illustrated with superb pictures, especially those taken from aeroplane by Dr. Barnum Brown over the Western United States and by Bradford Washburn in Alaska. Perhaps the most effective teaching device of the book, however, is the number of strip structure-surface diagrams, executed by Dr. Raisz, illustrating cross sections of the physiography of the various provinces. With but few lines, surface and underlying structures are surprisingly well indicated.

Dr. Atwood's volume is an excellent teaching book and it should expand the number of students and of courses offered in the basic study of the physiographic regions of the North American Continent.

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PLANT PHYSIOLOGY

Plant Physiology. By BERNARD S. MEYER and DONALD B. ANDERSON. New York: D. Van Nostrand Company, Inc. 1939. $4.50.

THIS book is undoubtedly the outgrowth of a rich experience in the teaching of plant physiology at two prominent American universities and must be classed among the best of the text-books dealing with the various phases of this subject. The thirty-seven chapters of the book are arranged in logical sequence. Prominence has been given in the first few chapters to a discussion of the important properties of solutions and colloidal systems and thus at the outset providing the student with a fundamental background for a better understanding of the biological processes involved in the complex living system. Although no attempt is made to discriminate sharply between the purely physical and the purely chemical characteristics of the subject-matter, the first eighteen chapters deal primarily with the physical phases of plant processes, while the following fourteen chapters are devoted largely to the factors and principles involved in the chemical aspects of plant life. The last five chapters, which deal with the factors involved in growth and movement, are rather brief (perhaps too brief) but may be adequate for the purpose intended. The discussion questions, suggestions for collateral reading and selected bibliographies at the ends of the several chapters have been selected with discrimination and if properly used should develop in the student accurate reasoning, a keen perception of principles involved in physicochemical processes and an understanding and appreciation of plant physiological material in general. The text material presented is based almost exclusively upon data selected from original sources, and in this a prominent place is given to the discussion of modern developments in plant physiology, without, however, neglecting the older concepts. The book is thoroughly up-to-date, but not particularly historical in its emphasis, a feature which, when the book is used as a class text, affords the instructor excellent opportunity to enrich the discussion of the subjects presented by amplifying the authors' presentation. The text material is presented in a manner so clear and definite that a minimum of efforts is required to understand the authors' meaning, which is never in doubt. A strong feature of this book, as a college text, is a minimum of controversial material and the honest attempt at evaluation of such conflicting evidence as is presented. When theoretical discussions are presented, they are duly stated as such to differentiate them from the purely factual scientific material.

The book is admirably adapted for use with large classes of undergraduates where adequate attention to the individual student by the instructor is only a remote possibility, nor is it too elementary to be exceedingly helpful to the appreciative graduate student in this field. It is a most welcome addition to the growing list of American text-books on this subject and fills a long-felt need for a comprehensive, thoroughly up-to-date college text-book of plant physiology.

JOHN W. SHIVE

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REPORTS

PHILANTHROPIC FOUNDATIONS[1]

THE Carnegie Corporation was specifically chartered for the advancement and diffusion of knowledge and understanding, and these words pretty accurately set forth the broad purposes of any non-specialized

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[1] Concluding part of the report of Dr. Frederick P. Keppel, president of the Carnegie Corporation, New York, for the year ending September 30, 1940.

American foundation. If this be true, the definite steps these foundations take in the realization of their purposes must of necessity center around inquiry and research for the advancement, and around education, taken in its broadest sense, for the diffusion of knowledge and understanding. Research is a cruelly overloaded word as it is used to-day, and while it may be assumed that an intelligent foundation will not be deceived by obvious misuses of the term, it must be recognized that some of the overloading is due to confused thinking by sincere and earnest people, one example being the efforts of a few years ago to transfer bodily the techniques of the natural sciences into the field of social and educational inquiry.

Certain grants for research have proved, though not always immediately, to be the best of all possible investments for a foundation to make; on the other hand, a research grant may prove to be an almost perfect device for wasting money. It is hard to assign either credit in the first instance, or blame in the second. All along the line the foundation is faced by a series of dilemmas in the selection of research enterprises to support. Here is a field in which the dollar provides no measuring line, for the necessary cost of any particular inquiry is a purely incidental feature which offers no criterion of relative usefulness to mankind. We are told, by those whose own researches have earned them the right to tell us, that nothing is more fatal than an attempt to regiment in any way the spirit of human inquiry, and yet our common sense tells us that the chances of success can not but be enhanced by environmental factors which *can* be controlled, such as adequate equipment, and understanding and stimulating personal contacts.

Fundamental research will always be a highly speculative enterprise, and the present foundation device for selection, while it can certainly be operated more carefully and more intelligently, is in general about as sound as can be hoped for. This device is to get, through consultation with experts, as fair a picture as possible of the fundamental nature of each proposed inquiry, and of the human qualities of the inquirer or inquirers, and then to leave the selection of those to be supported to the lay judgment of the board, decision to be made in terms not only of comparative promise, but also of the funds which the foundation itself may have available, and the chances of support from other sources.

And now, as to the second major channel of productive activity, education. Research can go it alone; education requires public approval and, if possible, public understanding as well. We have to-day the favorable factor of growing public interest in this our largest national industry. In such matters the radio serves as a useful barometer, and it is therefore significant that twenty-four coast-to-coast broadcasts were provided last year for a single educational meeting, that of the American Association of School Administrators. Much, however, remains to be done to clear the public mind as to what the public itself wants from education, and what it can reasonably expect, and by the same token to clarify the teachers' ideas as to what the processes of formal education can and can not do to affect the social order.

In the writer's judgment this whole matter of understanding, alike for the student, the teacher and administrator, and the public at large, must begin by the grasping of two or three fundamental concepts. The first is the enormous range in the native abilities of different individuals. This we "know" in one sense of the word, but we fail to make practical use of our knowledge. It is not so widely "known," but is demonstrably true, that there are corresponding qualitative differences in the various groups of human beings which constitute our universities and colleges and our other types of educational and cultural agencies, and it is equally demonstrable that most people act as if these differences did not exist. A fuller and wider understanding in both instances and a willingness to act in recognition of such understanding might do more than anything else to advance the cause of American education at all levels.

We recognize in our system of professional and vocational training the relationship between what we teach our students and what they must later do to make a living, but we are not nearly so clear as to the relationship between the durable general knowledge and the attitudes which the students acquire throughout their education, and the broad realities and the urgent needs of the adult life they must enter. In this connection the writer takes the opportunity to reiterate his conviction that as a people we have signally failed to get the use we might out of one of our most costly national investments, namely, the great body of our professionally trained men and women. They serve us as individual experts, it is true, but fail to serve as they might as united and influential citizen-groups in our communities. The responsibility for this failure must be laid at the door of education, including adult education.

We are ready to give lip service to the thesis that the logical unit, the center of education, must be the individual student and not the curriculum; but how precise is our thinking on what this means concretely, and how generally do we practice what we preach? How clearly do we grasp the underlying unity of the educative process as a whole, a process beginning for each human being with birth and ending only with death? The lines dividing education horizontally into pre-school, elementary, secondary, higher and adult education, and vertically according to subjects of study, have their usefulness certainly. So have our parallels of latitude and the meridians of longitude, but it is well to remember that these latter exist only on our maps; we never find them on the face of nature.

If it be true that a foundation of broad charter must of necessity concern itself primarily with matters of research and education, broadly conceived, and if the general considerations thus far presented, and others like them, are valid considerations, we find ourselves facing still another aspect of foundation responsibility. With rare exceptions a foundation can reach its objective only by working through another institution, and there are to-day in the United States far more universities, colleges and other operating institutions, and far more voluntary organizations for worthy purposes than the nation can possibly afford. In the years to come many of these are bound to disappear, and one of the most difficult duties that face the foundation is that of so directing its grants that its influence will be directed toward the survival of the fittest.

These various problems have forced themselves upon our attention during times which, by comparison at least, were normal. The inescapable fact that we are to-day in a tragically disordered world is in itself a further challenge to the foundation to justify its place as a social instrument enjoying exemption from taxation and other valuable privileges. In the face of falling income and increasing calls from every source, will foundations be able to find the things to do upon which their particular assets can be brought to bear most effectively? While they have their limitations, their natural advantages are many. They can move quickly. They can continue their support past the stage of novelty and publicity appeal. They can act with the long view in sight rather than under the pressure of the moment. They can call upon competent and disinterested advice. They can recognize and encourage excellence and the promise of influence and leadership in the individual, the group or the institution. They can find situations which it is to the general interest, but alas nobody's particular business, to clarify by research and experimental demonstrations. It need scarcely be added that no foundation has ever availed itself of these natural advantages to the full. It is equally true, however, that certain of them in the light of their own experience and of a wider public understanding of their responsibilities are each year giving greater weight to these matters in their decisions.

It is hard at any time for a foundation to keep its head amidst exigent and conflicting calls. It is doubly so in times of national tension and excitement—excitement in which, be it remembered, trustees, staff and advisers alike share. It is perhaps hardest, as pointed out in an earlier report, to go on with the familiar tasks, tasks so familiar that we are prone to forget that they may also be essential. Those of us who have had long years of experience in foundation work can not help recalling the errors and missed opportunities of the past, but on the whole, and all things considered, the writer is confident that the American foundation as an institution will meet the double challenge of a critical present and an unpredictable future.

FREDERICK P. KEPPEL,
President

SPECIAL ARTICLES

THE QUANTUM OF SENSORY DISCRIMINATION

THE human organism can detect a change in a stimulus when its intensity is increased by a sufficient increment. This increment alters, presumably, a level of excitation somewhere in the nervous system, and the change in nervous activity leads to a discriminatory response. Problem: Does the change in nervous activity proceed by infinitely small increments or does it proceed stepwise by finite increments or quanta? And are these quanta reflected in the discriminatory response itself?

The classical theory of psychophysics assumes that the frequency with which a given increment in a stimulus will be noticed is governed by the theory of probability,[1] and that an extremely small increment will occasionally produce a discriminatory response. The quantal theory, on the other hand, assumes a limiting value below which an increment will always fail to produce a noticeable difference. The contrast between these two theories is analogous to that between the classical theory and the "quantum theory" of physics.

But the existence of the sensory quantum is difficult to demonstrate. Almost without exception the experimental results conform best to the classical theory: the relative frequency with which an increment is perceived is related to the size of the increment according to a sigmoid function (the normal probability integral). The differential sensitivity of the organism is apparently "normally" distributed in time.[2] The quantal theory proposes that this result is due to the fact that the experimental procedures are usually such as to mask the differential quantum under a kind of random variability, but that under optimal experimental conditions the quantum can be detected and measured. Békésy[3] achieved results which suggest the existence of a sensory quantum and the present experiment was designed as a further test of the quantal theory.

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[1] J. P. Guilford, "Psychometric Methods," McGraw-Hill, 1936, p. 173. Guilford presents Boring's early argument regarding the applicability of probability theory to psychophysics. Boring later suggested the possibility of finding the sort of critical points in a sensory "continuum" which would demonstrate a "quantum theory." See E. G. Boring, *Am. Jour. Psychol.*, 37: 157–188, 1926.

[2] H. C. Montgomery, *Jour. Acoust. Soc. Amer.*, 7: 39–43, 1935.

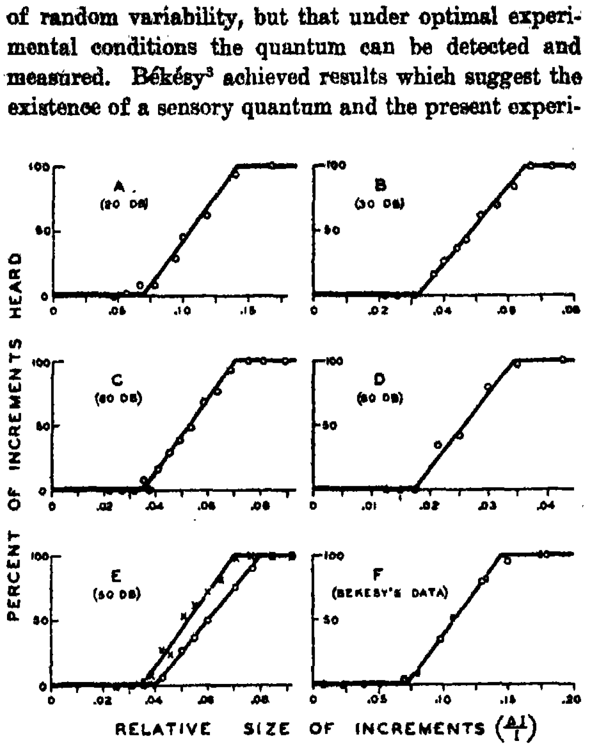

FIG. 1. Functions measuring the quantum of sensory discrimination. The solid lines are the theoretical functions and the points show the obtained frequencies with which various increments in the intensity (sound pressure) of a 1000-cycle tone are heard as increases in loudness. The size of the quantum, measured in terms of the stimulus ratio $\Delta I/I$, is given by the point on the abscissa where the *function first departs from* zero. The initial intensity, I, of the 1000-cycle tone (in decibels above the observer's threshold) is indicated on each plot, and the number of judgments, N, on which each point is based is indicated below.

Plot A. N = 50.

Plot B. N = 100. This function was obtained with an unfiltered tone, *i.e.*, the transition from I to I + ΔI was instantaneous. For this reason the *measured* size of the quantum is less than one would predict from plots A and C, where highly filtered tones were used.

Plot C. N = 100.

Plot D. N = 75.

Plot E. N = 50 for each set of data. The circles were obtained at the first sitting. The crosses were obtained after a rest period during which the observer drank a cup of coffee (which may or may not account for the displacement).

Plot F. Békésy obtained the circles for an increase and the half circles for a decrease in intensity (ΔI positive and negative). Békésy's experimental method introduced a systematic error (time-error?) which has been eliminated in Plot F.

Békésy presented a tone lasting 0.3 seconds, followed immediately by a second tone of the same duration but of variable intensity. In our experiment the observer listened to a continuous 1,000-cycle tone whose intensity was momentarily increased at intervals of 3 sec. The increase lasted 0.15 sec. The observer's task was to press a key whenever he heard an increase in loudness and to refrain from pressing the key when no change was detectable.

Results for a well-practiced observer (Volkmann) are pictured in Fig. 1. Two features of these curves should be noted: (1) The functions between 0 per cent. and 100 per cent. are rectilinear; they obviously do not conform to the normal probability integral—the phi function of gamma. (2) The point on the abscissa where the function reaches 0 per cent. is exactly one half of the value at which it reaches 100 per cent. The solid lines in Fig. 1 give the values predicted by the quantal theory on the assumption that the observer hears an increase in loudness whenever the level of nervous excitation is increased by an amount equal to *two* quanta. The argument is as follows.[4]

At a given moment the steady stimulus excites completely a certain number of neural quanta and leaves a sub-quantal *surplus* which "partially" excites some additional quantum. Due to an over-all fluctuation in the sensitivity of the organism—a fluctuation large compared to the size of a quantum—the time-distribution of the amount of this surplus is sufficiently random so that, at any instant, one amount of "partial" excitation is as likely as another. Now, the stimulus increment, ΔI, required to excite completely this "partially" excited quantum is smaller when the surplus is larger. Or, if we measure, as we must, the size of the quantum in terms of the increment, ΔI_q, which will *always* excite it, the ΔI just sufficient to complement the "partial" excitation and thereby excite an additional quantum is given by

$$\Delta I = \Delta I_q - p \qquad (1)$$

where p is the amount of "partial" excitation. A given ΔI will excite an additional quantum whenever $\Delta I \geqq \Delta I_q - p$. And since p fluctuates at random between $0 \leqq p \leqq \Delta I_q$, this condition will obtain a proportion of time given by

$$f_1 = \frac{\Delta I}{\Delta I_q} \qquad (2)$$

where f_1 is the relative frequency of the instants during which ΔI excites one additional quantum. The value of f_1 varies between zero and one.

Now, if *two* added quanta are needed to produce a just noticeable difference in loudness, equation (2) becomes

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[3] G. von Békésy, *Ann. d. Physik*, 7: 329–359, 1930.

[4] See also S. S. Stevens and H. Davis, "Hearing," Wiley, 1938, p. 145–147.

$$f_2=\frac{\Delta I-\Delta I_q}{\Delta I_q} \qquad (3)$$

and f_2 again varies only between zero and one.

Or, in terms of the percentage, P, of the increments which an observer should hear as increases in loudness

$$P=\frac{\Delta I-\Delta I_q}{I\Delta_q}\times 100 \qquad (4)$$

and P varies between zero and 100.

The functions in Fig. 1 fit equation (4) provided we interpret ΔI_q as the abscissa value where the functions first depart from 0 per cent. This value measures, in terms of the stimulus, the size of the differential quantum for loudness discrimination.

The conventional procedure is to measure differential sensitivity in terms of the 50 per cent. point on the functions in Fig. 1, but this measure gives a value half again as large as the differential quantum.

Békésy's procedure enabled him sometimes to get discriminations based upon the addition of a single quantum. After many hours of practice he obtained a rectilinear function parallel to that in Fig. 1 F, but intersecting the abscissa at zero. Under our own procedure a discrimination requires the addition of two quanta because the excitation due to the continuous tone against which the observer makes his judgments fluctuates up and down at random by single quantal jumps. From this "steady" tone condition only double quantal jumps can be discriminated.

It is important, finally, to emphasize the difficulties involved in measuring the differential quantum. Data fulfilling exactly the predictions of equation (4) are the exception, not the rule. Usually one obtains sigmoid functions, because almost any kind of "error" in the experiment tends to move those points lying near the elbows of the function farther toward the 50 per cent. region. Compensatory errors tending to move points to a position below 0 per cent. or above 100 per cent. can not, of course, occur. Also, if the size of the quantum changes during an experiment the process of averaging produces a sigmoid function. Thus the data in Fig. 1 E, obtained in two different experimental sessions, would, if averaged, reduce to a sigmoid curve. As it is, these two sets of data fit rectilinear functions whose slopes are those required by equation (4).

It is of crucial importance that the interval of time between the presentation of the standard stimulus, I, and the comparison stimulus, I + ΔI, be short. Data satisfying equation (4) are not obtained when the over-all sensitivity of the organism is allowed to change during the interval between the two stimuli.

Given an adequate experimental procedure in which these and other factors are kept favorable, it is apparently quite possible to reduce the random variability expected under the classical theory to the restricted variability predicted by the quantal theory of sensory discrimination. The confines of this restricted variability provide a stimulus-measure of the differential quantum.

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A NEW ESTROGENIC SUBSTANCE PRESENT IN THE NEUTRAL FRACTION OF HUMAN PREGNANCY URINE[1]

THREE well-defined crystalline substances have been isolated from human pregnancy urine. These substances, estrone, estradiol and estriol, each have among other similar chemical properties a phenolic hydroxyl group in position three of ring A.[2,3,4] By virtue of this property these substances are soluble in alkali and may be extracted from an ether solution by means of an aqueous solution of sodium hydroxide. This communication deals with an estrogenic substance in human pregnancy urine which can not be extracted by aqueous alkali from an ether solution and, therefore, appears to be a neutral substance.

The pregnancy urine concentrates employed in this study have been prepared by two different procedures. The concentrates employed in experiments numbers 1 and 2 (Table I) were prepared as previously described.[5] This method involves the extraction of acidified boiled urine with benzene. The acidic and phenolic substances are separated by means of a 10 per cent. aqueous solution of sodium hydroxide. The neutral fraction or alkali insoluble fraction was then subjected to repeated extraction with aqueous 10 per cent. sodium hydroxide as indicated in Table I. The concentrate used in experiment number 3 was prepared by

TABLE I

Experiment number	Quantity of human pregnancy urine Liters	Number of separations* with 10% NaOH	Estrogenic activity in alkali-insoluble fraction I.U./Liter
1	11	30	52
		55	55
		80	48
2	12	50	21
3	3,800	70	20

* These separations were carried out by dissolving the extract in ether and extracting the ether layer with an equal volume of 10 per cent. aqueous sodium hydroxide.

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[1] Aided by grants from the Committee on Scientific Research of the American Medical Association and the Rockefeller Foundation.

[2] S. A. Thayer, L. Levin and E. A. Doisy, *Jour. Biol. Chem.*, 91: 791, 1931.

[3] D. W. MacCorquodale, S. A. Thayer and E. A. Doisy, *Jour. Biol. Chem.*, 99: 327, 1933.

[4] G. V. Smith, O. W. Smith, M. N. Huffman, S. A. Thayer, D. W. MacCorquodale and E. A. Doisy, *Jour. Biol. Chem.*, 130: 433, 1939.

[5] R. I. Dorfman, J. W. Cook and J. B. Hamilton, *Jour. Biol. Chem.*, 130: 285, 1939.

extracting the acidified urine with butanol and concentrating the butanol in vacuum. The concentrate was then subjected to alkaline hydrolysis followed by acidification to the neutral point and extraction with ethyl ether. The phenolic compounds were separated by extracting the ether solution with dilute alkali. The neutral fraction was chilled in order to remove the bulk of the pregnanediols.[6] This alkali insoluble fraction was dissolved in ethyl ether and subjected to repeated extractions with aqueous 10 per cent. sodium hydroxide as represented in Table I.

All essays for estrogenic activity were performed on the adult spayed mouse in parallel with estrone. All values are expressed in International Units (I.U.)

In Table I we see that after exhaustive extraction of an ether solution containing principally alkali insoluble substances with a solution of sodium hydroxide, between 20 to 55 I.U./liter of estrogenic activity is still detectable in the concentrate of neutral compounds. That this estrogenic activity is not merely due to some phenolic estrogen has been demonstrated by two experiments. First, as the number of extractions with alkali of the ether phase is increased from 30 to 55 and finally to 80 in experiment 1, no significant decrease in estrogenic potency of the neutral fraction could be demonstrated. Second, when 3 mgm of estrone (30,000 I.U.) were added to a concentrate of neutral compounds from normal female urine, less than 25 I.U. of estrogenic activity was found to be present in the neutral fraction after 20 separations with alkali.

Since it is well known that dehydroisoandrosterone, which has been isolated from human pregnancy urine, has certain estrogenic effects, it becomes necessary to inquire as to the possible role of this substance in these observations. A portion of the concentrate containing 1080 I.U. of activity prepared in experiment 3 after 70 separations with alkali was separated into ketonic and non-ketonic fractions. The ketonic fraction which contains the dehydroisoandrosterone assayed less than 300 I.U. while the non-ketonic fraction contained the bulk of activity or more than 800 I.U. Thus it appears that the principal estrogenic activity resides in the neutral non-ketonic material. Further work is under way to ascertain more of the chemical and physiological properties of this material.

SUMMARY

In addition to the well-defined phenolic estrogens in human pregnancy urine there appears to be another estrogenic substance which is a neutral non-ketonic compound.

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[6] Thanks are due to Dr. O. Kamm of Parke Davis and Company for carrying out this procedure.

CONCENTRATION AND PARTIAL PURIFICATION OF EQUINE ENCEPHALOMYELITIS VACCINES[1]

CHICK embryo vaccines[2] employed in the immunization of horses against the virus of equine encephalomyelitis and, in special instances, for human vaccination,[3] have consisted thus far of crude saline extracts of virus-diseased tissue containing about 0.4 per cent. formalin. The quantity of vaccine given, usually a total of 20 cc of a 2 per cent. extract for horses and 4.0 cc for man, has been determined by quantitative relations with respect to the physical amount of immunizing principle present in them. With the necessary amount of specific antigen, there have been introduced simultaneously relatively large quantities of inert chick embryo material and formalin. A high degree of concentration and purification of the immunizing principle can be accomplished,[4] though on an impractical scale, by ultracentrification. Recent experiments have shown that the virus of equine encephalomyelitis is insoluble[5] in acid solutions of hydrogen ion activity not injurious[6] to the virus in brief periods. The antigenic formalin derivative[7] of the purified virus is likewise insoluble under similar conditions and can be sedimented quantitatively in the ordinary angle centrifuge. On the basis of these findings a greatly concentrated and partially purified vaccine has been prepared by procedures suitable for practical application.

Chick embryo vaccines were prepared in the routine way by adding formalin to 0.4 per cent. concentration to a 20 per cent. suspension of virus-diseased chick embryo tissue in Ringer solution. When inactivation of the virus was complete, the suspension was adjusted to pH 7.5 and cleared of gross material by spinning in the angle centrifuge at about 4,000 g for 30 minutes. By the addition of 0.2 N hydrochloric acid, the pH of the resulting supernatant fluid was reduced to 4.8 and the turbid suspension was immediately spun in the angle centrifuge at 4,000 g for 30 minutes. This supernatant fluid was discarded and the sedimented material taken up in Ringer solution so that the total volume was one tenth that of the initial volume of crude vaccine. The pH was immediately brought to

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[1] This work was supported by a grant from Lederle Laboratories, Pearl River, N. Y., and by the Dorothy Beard Research Fund.

[2] J. W. Beard, H. Finkelstein, W. C. Sealy and R. W. G. Wyckoff, SCIENCE, 87: 490, 1938.

[3] J. W. Beard, D. Beard and H. Finkelstein, *Jour. Immunol.*, 38: 117, 1940.

[4] J. W. Beard, H. Finkelstein, W. C. Sealy and R. W. G. Wyckoff, SCIENCE, 87: 98, 1938.

[5] A. R. Taylor, D. G. Sharp and J. W. Beard, *Jour. Infect. Dis.*, 67: 59, 1940.

[6] H. Finkelstein, W. Marx, D. Beard and J. W. Beard, *Jour. Infect. Dis.*, 66: 117, 1940.

[7] D. G. Sharp, A. R. Taylor, H. Finkelstein, D. Beard and J. W. Beard, *Proc. Soc. Exp. Biol. and Med.*, 43: 650, 1940.

7.0 by the addition of 0.5 N ammonium hydroxide. The concentrate thus obtained has approximately the same nitrogen content per unit volume as the crude vaccine indicating the elimination of 90 per cent. of the total protein originally present. A comparable proportion of formalin is also discarded in the acid supernatant fluid.

TABLE 1

IMMUNIZATION OF GUINEA PIGS WITH CONCENTRATED AND PARTIALLY PURIFIED WESTERN STRAIN EQUINE ENCEPHALOMYELITIS VACCINE

Preparation	Dose† cc	Route	Test for immunity‡	
			Vaccinated	Control
Crude vaccine	0.5	Subcu.	4/4	0/5
Concentrated vaccine	0.1	"	5/5	
	0.05	"	5/5	
	0.1 *	"	3/3	
	0.05*	"	5/5	
	0.1	Int. derm.	5/5	
	0.05	"	4/4	

† The amount given in each of 2 injections with an interval of 7 days.

‡ 500–1,000 mouse infectious units of virus were given intracerebrally 14 days after the second injection of vaccine. The numerator indicates the number of animals surviving the challenge dose and the denominator the number of animals in the test.

* Diluted to corresponding volume of crude vaccine.

The capacity of a Western strain vaccine concentrate to immunize guinea pigs is illustrated by the results of a typical experiment shown in Table 1. Similar experiments have been made in which the effectiveness of smaller volumes of crude vaccines was compared with that of corresponding volumes of concentrated vaccines. The results have shown that, within the limits of the immunological tests, the immunizing principle is quantitatively concentrated and not damaged by precipitation in acid solution. This is substantiated by examination of the concentrate with the analytical ultracentrifuge. Like findings were obtained with Eastern strain material similarly prepared.

As shown in Table 1, the concentrated material confers protection, whether it is given subcutaneously or intradermally. The small volumes of it containing an effective immunizing dose are compatible with the practical utilization of the concentrated vaccine through routine intradermal administration.[8] The elimination of most of the formalin and chick embryo protein associated with the necessary amount of vaccine may be of considerable significance with respect to lessening or abolishing reactions sometimes attending the vaccination of horses[9] and man,[10] especially following the second or subsequent course of injections of crude vaccines. Of still greater promise in this direction are the possibilities associated with combination of intradermal injection and the greatly reduced quantities of formalin and inert protein.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN A-C POWERED PH SET

ONE method to determine the PH of a solution is to measure the EMF developed between a glass PH electrode and an "indifferent" electrode, both placed in the solution. This EMF is of the order of a few tenths of a volt and changes about 60 millivolts per PH unit. In practice any steady component of this EMF may be balanced by means of a potentiometer in series with the indifferent electrode. The changes of EMF, which reflect the changes of PH, are observed and recorded by suitable apparatus. Such an apparatus is commonly called a current amplifier or an impedance changer, though the latter term is a misnomer. The chief requirements of such a device are (1) that it have high input impedance, and (2) that it not fluctuate spontaneously. An A-C powered current amplifier which fulfils these conditions is described below.

In Fig. 1, the controlling voltage is applied to the third grid of a 6J7 pentode tube. This grid is biased about 3 volts negative, the second grid and the plate are each about 25 volts positive. The first grid is tied to the cathode. Thus the usual connections of G_1 and G_3 are interchanged. The effect of G_3 then is to change the distribution of current between G_2 and the plate.

Fig. 2 illustrates 3 possible paths for an electron after it leaves the cathode: (A) it may go straight to screen; (B) it may go through screen and G_3 and on to plate; (C) it may go through screen and be so repelled by negative G_3 that it is sent back to the screen.

If G_3 is now made more negative, the number of electrons following path C will be increased and the number following path B will be correspondingly decreased. Thus screen current increases, plate current decreases, but the sum of the two remains constant. Now, it is the difference of plate and screen currents that affects the galvanometer G.

Any disturbance in the tube, such as a change in cathode emission, or a change in B supply voltage, will affect both plate and screen currents in the same direction, but will have little effect on their differ-

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[8] H. W. Shoening, M. S. Shahan, O. L. Osteen and L. T. Giltner, *Vet. Med.*, 35: 377, 1940.

[9] H. W. Shoening, *Jour. Amer. Vet. Med. Asn.*, 97: 39, 1940.

[10] D. Beard, H. Finkelstein and J. W. Beard, *Jour. Immunol.* In press.

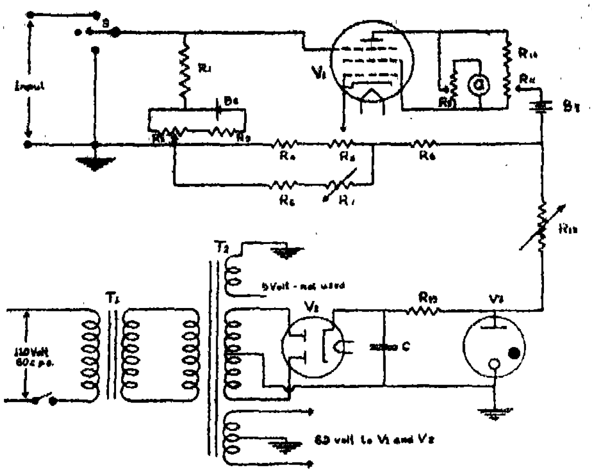

FIGURE 1

R_1	100	meg S S white 65 X Resistor
R_3	10	meg " " "
R_4	500	ohm International Resistance Co.—Type A B Resistor
R_5	2000	" " " " "
R_8	2000	" " " " "
R_{10}	5000	" " " " "
R_{13}	7500	" " " " "
R_2	1	meg Potentiometer (on panel)
R_6	200	ohm (Yaxley X) " " "
R_7	200	" " " " " "
R_9	20000	" " A-20-MP " " "
R_{11}	5000	" " A -5-MP " (behind panel)
R_{12}	10000	" " A-10-MP " " "
S	switch	" 161-C (on panel)
C		8 μfd 450 volt electrolytic condenser
T_1		constant voltage transformer (Sola 3000)
T_2		Thordarson T 13R19 transformer
V_1		RCA 6J7 in Steatite socket (Amphenol R-SS-8)
V_2		6 X 5 tube
V_3		VR-105 tube
G		galvanometer

One PH unit or 60 millivolts input will cause 8 microamperes to flow through G when R_9 is set at maximum sensitivity. Thus the required galvanometer sensitivity can be calculated in terms of the PH range it is desired to cover.

ence. Hence the galvanometer is not much affected by such disturbances.

The response of the galvanometer to changes in filament voltage can be reduced nearly to zero by the proper adjustment of R_{11}.

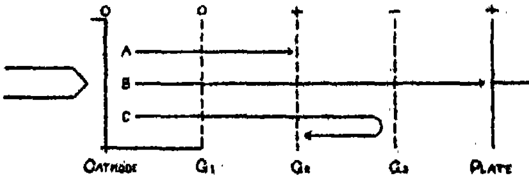

FIGURE 2

If a small extra source of voltage such as a battery be inserted in series with the plate and screen supply, it becomes possible to adjust R_{12} so that the set is practically insensitive to changes in B voltage. The effect of fluctuations of B voltage is always small, however, and the above expedient may not be necessary. We find 1.5 to 4.5 volts suitable for the battery.

The resistor R_0 is used to adjust to free grid—*i.e.*, so that the galvanometer does not shift as the switch is rotated from the short to the open position. The grid current, however, is always very small in this tube, so this adjustment and the bias cell might well be omitted.

We have used RCA 6J7 tubes. They must be selected, as they are not uniform. The shell must be grounded—not connected to cathode. 6SJ7 and 6J7-G tubes have not been satisfactory.

The important features of this design are (1) the push-pull connection between plate and screen of a single tube, and (2) the cascaded use of several devices to secure isolation from line voltage variations.

In the present design we have (1) the regulating transformer, (2) the gaseous discharge tube, (3) the push-pull connections. None of these would be good enough alone to absorb line voltage variations completely and provide stable operation. Since each of these devices gives only a moderate degree of isolation, none is critical in design or adjustment.

If the whole task of isolating the set from the line depended on one regulator or one push-pull connection this would involve a quite critical adjustment. Such an adjustment might be subject to spontaneous drifts. The cascade circuit gives ample isolation with *no* critical parts.

Since most experimenters wish to record PH over a relatively long period of time, the elimination of batteries without loss in stability will prove to be a convenience.

CRAIG W. GOODWIN

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IDEALS OF SCIENCE[1]

By Dr. ALBERT FRANCIS BLAKESLEE

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WE are gathered to-day to dedicate not merely a building but to perpetuate an idea—the ideals of science. It seems fitting therefore to say a few words in appraisal of science: what science has done and what it may do.

Modern civilization is in large measure the product of science. Recently, however, some have challenged the value of science on account of the baneful effects of certain of its applications. They grant the increase in material comforts which the applications have brought about, but say the cost is greater than the gain. The weapons of modern warfare made possible by science are held responsible for the appalling loss of life, rather than the wayward mind of man. Even if we should take these criticisms at their face value it would be possible to show that science has greatly lengthened rather than shortened the average span of life. Preventable disease has taken greater tolls than war. During the World War, Germany lost one and three quarter millions, killed or died during service. This is less than 3 per cent. or one out of 36 of the total population of about 65 million people in Germany at that time. During the plague of London in the seventeenth century, 15 per cent. of the population, or more than one in seven, died of the Black Death during a two-year period. This is ten times the German mortality rate during the World War. Later when the plague was introduced into Marseilles it killed almost half the population there. During the seventeenth century the plague carried off twenty-five million people in Europe, or a quarter of the population.

The plague has been a periodic scourge to mankind since long before the time of Christ, but thanks to the applications of science we no longer dread its ravages.

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[1] Address delivered at the dedication of the John H. Harrison Science Building at DePauw University, Greencastle, Indiana, October 19, 1940.

Other examples could be given to show that the discoveries of science have saved more lives than have been lost through the applications of science.

These arguments against science are based upon a misconception of what science can do. Science is impersonal. It merely provides tools in the form of a body of knowledge, instruments such as the microscope with which to delve deeper into the unknown, methods of studying nature, and points of view. How these tools are used is not the fault of science as such. The use is determined by the aims of human beings, some with good and some with bad motives; some ignorant, some informed. Goodness of motive does not alone determine whether an action is beneficient or baneful. Witness the inquisitions of the church in their well-intentioned campaigns to better mankind, and the Salem witchcraft trials which are connected in the public mind with the Reverend Cotton Mather. In the Civil War, churches on both sides prayed for the success of their own cause and the same was true in the last World War. Even the Church follows the flag. Moral judgments when colored by personal interest are unsafe guides to conduct.

It is true that technological applications of scientific discoveries have brought us material comforts, but they have been too often recounted and their emphasis tends to obscure the real values of science. Technological applications and physical comforts are not the greatest gifts that science has to offer to mankind. Lincoln has been called an emancipator. He liberated people from physical bondage. Science has been a greater emancipator. It has liberated humanity from the shackles of ignorance and superstition. It has freed men's minds. It has disclosed nature and from this knowledge man may walk in accord with nature's ways. The influence of science on human betterment is usually indirect. As an example, the ancients used human sacrifices to ensure bountiful harvests. We use commercial fertilizers, not primarily because we feel human sacrifice is morally wrong, but because we have learned by experience that commercial fertilizers yield better results. With new knowledge superstitions based on untenable premises gradually fade away. Thus before the behavior of chromosomes and genes was understood, it seemed reasonable to believe in "maternal impressions"—that, for example, if a pregnant mother was chased by a turkey gobbler, the child's face was likely to be "marked" with a red birthmark. Such a belief, as also that in so-called "acquired characters," is no longer held by informed people, since it runs counter to the known mechanisms of heredity.

The recent findings of genetics in plants and lower animals are having a profound effect upon man's philosophy of life—or should have. The realization that no two people are exactly alike or ever have been, that human differences are due to factors of heredity which are innate as well as to influence of the environment, can not but change our attitude toward problems of education, rewards and punishments, and all efforts for human betterment. The environment can be readily controlled; the heredity can be controlled only by genetic methods. There seems no good evidence that man to-day is inherently better physically, mentally or morally than at the dawn of history. Through changes in environment, however, man has risen far in social evolution. Many of the gains have been called moral, since they tend to benefit mankind as a whole. This does not prove that the moral nature of man has changed. It may merely show that what we call morality has been found to be profitable in the long run. Despite lapses of individuals and of nations, I believe morality does pay and will prevail as the recognized standard of life. Those who think otherwise I trust in time will come to agree with the man who said, "Honesty is the best policy. I have tried both." Time may come when man will attack the problem of his own biological evolution and man may then become better morally as well as mentally and physically.

Last month I had the privilege of taking part in the Bicentennial of the founding of the University of Pennsylvania in 1740 by Benjamin Franklin. It was interesting to review the state of science at that time. In the first place, there were no laboratories then and few who could be called scientists. Franklin probably knew personally or through correspondence all the scientists there were in this country and most of those abroad. In Franklin's time there was hardly a chemistry since the atomic theory had not yet been proposed by Dalton. Two hundred years ago a little was known about static electricity, but the Leyden jar was not yet discovered and nothing was known about galvanic and induced electricity. Here are some of the biological things that were not known two hundred years ago: the binomial system of naming plants and animals, later introduced by Linnaeus; bacteria as causes of disease; experimental work in hybridizing plants, started by Koelreuter; the cell theory; the theory of organic evolution; chromosomes, genes, hormones, vitamins. Knowledge of the mechanisms of heredity has been developed entirely within the last forty years. It is certainly true for biology and perhaps for most other branches of science that more progress has been made in the last one hundred years than in all time before. Equally important examples could be mentioned from other fields. The selected items I have mentioned that Franklin did not know are not technological advances but fundamental discoveries, many of which have, however, formed the basis for technological applications of great value.

Franklin, though perhaps the foremost citizen, philosopher and scientist of his time, knew relatively little of the orderly processes of nature. To him the universe was fashioned in six working days by a mechanistic God. To his time, all men were created equal and environment (with the occasional aid of Divine Grace) was considered the sole arbiter of man's fate.

In Franklin's time science had little or no place in the educational curriculum and there are those to-day who would deny cultural value to study of nature. To us, science is not to be defended primarily because of its utilitarian values except perhaps in such professional schools as those of engineering. It should rank in cultural value with art, literature, and music, since science also nourishes the spirit.

I had chosen as my topic for this morning's talk "The Ideals of Science." I have come to the conclusion, however, that strictly speaking there is only one ideal of science—the search for truth. The searchers for truth, the scientists, have developed ideals for their endeavors, but they are human beings with human emotions and frailties and, like the rest of humanity, their opinions are consciously or unconsciously tinged by personal interest. Personal interest, however, does not give added weight to conclusions of science. We need emotion as a motive force to our labors, but the more heat in our emotions the more likely we are to be blinded in our conclusions. First among the ideals of scientists is freedom of thought and its expression. A censorship on what problems may be studied and on what conclusions may be reached is lethal to science. The scientist covets for all the freedom to investigate any problem, economic, social, governmental or other human activity as well as problems of genes and electrons, and to state conclusions whatever their effect on current beliefs. In his search for truth, the scientist attempts the difficult task of accepting realities though unpleasant. With Thomas Huxley he can say "God give me strength to face a fact though it slay me."

Cooperation is an ideal of scientists. Whether we realize it or not, each is working with a multitude of collaborators, of the past and of the present. Discoveries are not made in a vacuum but are the culminating result of the labors of many on whose shoulders we rise. The present also has an unconscious influence. We often hear the expression "Leaders of Science." As a matter of fact so-called leaders often lead less than they are pushed. The advancement of science is like that of an amoeba—a mass movement with individual projections extending only a slight distance beyond the advancing edge. It is for this reason that so frequently important discoveries have been made independently at about the same time. This was the case with the rediscovery of Mendel's law of heredity. Mendel communicated his discovery to Naegeli, an acknowledged leader in heredity, and his published paper was cited in Focke's "Cyclopedia of Hybridization." Mendel's discovery remained unused for over thirty years, until 1900, when it was independently rediscovered by three other investigators. Biologists in unconscious cooperation had brought their science to a stage in 1900 at which the early discovery of Mendel's law was an inevitable event. If de Vries, Correns and Tschermak had not made the discovery, others would have done so soon.

Another example near our day. Thirty-six years ago, at our Department of Genetics in Cold Spring Harbor, a building was dedicated to the study of experimental evolution. Hugo de Vries, the world's leading student of heredity, was brought from Holland to make the address. He advised the use of the recently discovered radiations of radium and x-rays to penetrate into the interior of cells and induce mutations in what we now call genes. Some of the leading geneticists of the time heard the address and it was published, but again the time was not ripe and the advice fell on stony ground. About twenty-five years later the effective use of x-rays in inducing gene mutations was announced by a worker with *Drosophila*, but others independently had already started radiation experiments for the same purpose. None of these workers had known of the advice of de Vries. The stage was set for the discovery, and it could not have been long delayed. My purpose in giving these examples, which I believe are not exceptional, is to emphasize the part that the scientific environment plays in the advancement of science. The individual so-called leaders of science could probably be eliminated without so much loss as most would imagine. It is the mass movements that really count. They furnish a scientific atmosphere, as it were, to which we all may contribute our bit.

I need not stress the obvious advantages of voluntary cooperation, especially between those with different techniques and different points of view. Science knows no bounds of nationality or creed. There is not a Japanese wave-length of light nor a German atom of carbon. Consciously or unconsciously all nations have cooperated in building our present structure of science. International congresses testify to the value of international cooperation in science.

Another ideal of scientists is tolerance. The experienced investigator knows too well how hard it is to close every rat hole where an error might have crept into his calculations. His chief demand of others, as of himself, is honesty and a reverence for the truth and withal a willingness to change his opinion when facts show his views are wrong.

Science may be advanced in many ways. We think of research, education and support by public and private agencies. Each plays its special part. Few can compose music; most of us can enjoy music and some can help in the financial support of music. Patrons of the arts have made possible our present museums with their priceless treasuries of the best thoughts of the past. It would be as unwise to attempt to force all into careers of research as into careers of musical composition. All, however, should have the privilege of knowing and enjoying at least some phase of science. The problem regarding the supply of new leaders of science is to catch them early and give them increased opportunities for the development of their exceptional powers. The problem for those who are enjoyers of science without professional intent is the accurate but interesting presentation and dissemination of scientific knowledge. Beside the formal educational institutions, such agencies as Science Press and the members of the National Association of Science Writers are contributing to the solution of this problem. The problem for the potential patrons of science is the realization that their benefactions are investments in science which should be scrutinized as carefully as a purely financial venture in order to ensure adequate dividends in scientific returns. We congratulate this university that its patron not only provided the funds with which to erect this beautiful temple of science but also had the foresight to provide a permanent endowment in the university which could be used towards its continuing support.

These are dark days throughout the world when in many countries science has been as effectively bombed by governmental fiat as have stately edifices been bombed by missiles from the air. What of the future of civilization, we are asked, and what part has science to play? Turning the pages of history gives us scant comfort. Civilizations widely separated in time and space have flourished and disappeared. Is ours also to obey the laws of growth, decay and death? In the warm summer it is hard to think of winter's cold, and we instinctively feel that our civilization will endure; we have gone so much farther on the upward road, we say, that the curve must continue to rise. It is dangerous to extrapolate the future from the present. Think of the temperature curve of H_2O. Starting with water at room temperatures there is a gradual decrease in volume until at 5 degrees the volume begins to change in the opposite direction and a sudden expansion takes place as the liquid changes to a solid, ice. From the slight range of room temperatures it would not be possible to predict the sudden reversals of the curve, as water freezes. It is equally impossible to be sure that the curve of our civilization will continue its upward trend. There is one fact, however, that may be a ray of hope to our calculations. Science has reached a stage of development in our time that no other civilization has known. The experimental method, for example, has only recently become of use. Scientific methods are now available as never before for study of all phenomena of nature, even that of a sick civilization. It is my trust therefore (though this may be wishful thinking) that science will find a remedy for our present international ills as it has for many a pestilence that walketh in darkness. If and when the time comes for restoration of peace and good will, I believe science may lead the way. I attended the International Congress of Genetics in Edinburgh last fall which was broken up by the advent of war. Some of the members belonged to countries where now liberty is but an empty name. Science had brought us together individually as friends and we separated as friends when the congress was prematurely disbanded. We trust that the internationality of science will some day bring us together again as friends.

We are all the privileged legatees of the past, rich from the toil and sacrifice of those of other days. America is favored as nowhere else. Our science is still free. American science therefore has an especial duty to keep aflame the torch of free research for truth, which is dimmed or gone out in so many lands. We believe that when the goddess of truth is seen snatched from her temple and publicly trampled under foot, our duty is not merely to mildly protest but to summon up our emotions as men and to fight with all the moral energy at hand, fight not merely for the preservation of our own land and the spiritual values we have gained but for freedom throughout the world. In science all nations are one people and the world can not endure part free and part slave. We are not without hope in the ultimate salvation of mankind. We believe that the free search for truth by the methods of science has power to rebuild the world and we have faith that it will prevail.

THE STATE SCIENTIFIC SURVEYS OF ILLINOIS[1]

By Professor W. A. NOYES

UNIVERSITY OF ILLINOIS

THE Board of Natural Resources and Conservation is a non-political organization, the members of which are appointed by the governor of the state but are selected because of their expert scientific training in lines closely related to the work of the State Surveys. The original board was appointed in 1917 by Governor

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[1] An address given at the dedication of the Natural Resources Building at Urbana, Illinois, November 15.

Lowden and included such men as T. C. Chamberlin and John M. Coulter, of the University of Chicago. William Trelease and I of the University of Illinois were also appointed by Governor Lowden and have been reappointed by successive governors, irrespective of their political affiliations or of ours. The board controls the work of the surveys and approves all appointments of the employees, including the chiefs. No member of the staffs of the surveys has ever been appointed for political reasons.

The Geological and Natural History Surveys are housed in the building which we dedicate to-day. The building has been constructed with funds supplied by the state to the Department of Education and Registration. The Federal Government has also furnished, through the P.W.A., a very considerable part of the fund used. The State Water Survey has its office and laboratories in quarters furnished by the University of Illinois in the chemistry building.

The State Water Survey studies the water resources of the state, which have a value of more than 50 million dollars annually, in spite of the fact that water is said to be free as air. During recent years it has developed methods of fermenting the organic matter of industrial wastes which were formerly allowed to run off in the streams of the state, killing the fish in some of our large rivers. The fermentation yields methane, a gas used for heat and power, and worth enough to pay for the cost of the process. Very recently the survey has been studying the structure of the water molecule in cooperation with the division of physical chemistry in the department of chemistry. The results are of great importance scientifically and also of value in biology and in industry.

The members of the State Water Survey have recently been called upon to do important work for the national defense.

The Geological Survey has become an integral factor in the industrial development of the state. Its researches aid the mining and quarrying industries, those manufacturing industries which use minerals as raw materials, the various railroads in their development of industries along these lines, engineers engaged in the design and construction of large structures, bridges and pavements, and cities and industries throughout the state who seek more adequate sources of ground waters. It helps the clay industries of the state. The large coal resources of the state are also of great importance. All these are of vital consequence to our standards of living. In certain phases of its work the Geological Survey cooperates with the Department of Ceramic Engineering and the Department of Mechanical Engineering of the Engineering Experiment Station and with the Department of Geology of the University of Illinois, and also with the Departments of Geology of the University of Chicago and of Northwestern University. To the Geological Survey is entrusted the topographic mapping of the state, and in this work it cooperates with the U. S. Geological Survey.

With national defense looming large, the mineral resources of Illinois, located in the interior of the continent, promise greater development. In 1938, the value of the mineral production was 160 million dollars, and in 1939, 283 million dollars, an increase of 123 million dollars. Significant is the fact that Illinois' new oil fields, in whose development the Geological Survey played an important part, produce three times as much oil as the fields of Rumania produced just before the opening of the present world war. With industry necessarily playing a vital part in the national defense program, the Geological Survey's contribution in research and advice will be of greater value and in greater demand.

The Natural History Survey is concerned with research in the state's great wealth of renewable natural resources, those resources that under adequate protection and wise utilization are inexhaustible. In certain phases of its work it cooperates intimately with the Agricultural Experiment Station of the University of Illinois.

Upon the results of the experiments of the Natural History Survey are based control measures for the destructive insects and diseases that threaten agricultural crops, income from which approximates annually a half billion dollars in value, the greenhouse industry with its annual crop value of fourteen million dollars and the forest industry with its six million dollar annual income. These figures do not include the income from nursery products, truck crops and numerous smaller but important industries associated with some phase of agriculture or with utilization of renewable natural resources. When the destruction of a large part of the corn crop was threatened by chinch bugs, a few years ago, it is estimated that through the advice of the Natural History Survey of the Agricultural Experiment Station a loss of three million dollars to the farmers of the state was prevented.

Upon the results of its studies are based management practices intended to preserve and increase the once abundant but long neglected wild life of the state, the fish, the furbearers, the waterfowl, the quail, the prairie chicken and other upland birds. The value to the people of Illinois of the wild-life resources transcends their estimated monetary value over a million dollars annually for furbearers, nearly half a million dollars annually for waterfowl, birds and small animals. The 400,000 Illinois citizens who annually purchase fishing licenses, the 280,000 who annually buy hunting licenses find in their close association with the outdoors an esthetic value far above any monetary value they derive.

In times of international stress, the wild-life resources of the state become of increased value as a means of taking its citizens into the open and of preserving their mental balance and their collective sanity. In times of national emergency, the food resources of a country are its first line of defense. Protection of its agricultural crops from the ravages of insects and diseases is a primary objective in any effective defense program.

THE RESEARCH LABORATORY OF THE GENERAL ELECTRIC COMPANY[1]

By Dr. WILLIAM D. COOLIDGE

VICE-PRESIDENT OF THE COMPANY AND DIRECTOR OF THE LABORATORY

THE significance of our laboratory's work, in its three aspects—to our company, to the world of science and to industry—has been discussed by Mr. Wilson, Dr. Compton and Mr. Ferguson, respectively. They have been most generous in awarding us credit on all three counts, and those of us here, who are working, or have worked in the laboratory, have been heart-warmed and thrilled by their exceedingly kindly appreciation. We know each of them well enough to know his complete sincerity, so we accept their praise at its full value and acknowledge it with deeply sincere gratitude. Their mere presence here would be, were it needed, complete proof of their interest in our work, for, even in these busy and anxious days, it would be hard to select three men who are carrying heavier burdens and responsibilities than are, each in his own field, these three. For their taking time to come to this birthday party and for their most kindly contributions to it, we return our heartiest thanks.

We offer our thanks also to the civic leaders of cities where our plants are located, to the science editors and other representatives of the press, to the educational and industrial leaders of our own city and to our many friends in the General Electric Company who have graced this celebration by their welcome presence.

For me to add anything to what the preceding speakers have said about the laboratory's work would be in the nature of an anti-climax, but, since they have spoken, as it were, from the outside looking in, so perhaps I may say a few words from the inside looking out, in regard to the relations of the laboratory to science and industry, or rather perhaps on the aspect of the laboratory as a catalyzing agent which has helped to bring about a momentous reaction between the two.

Forty years ago the attitude of science toward industry was mostly one of aloofness, frequently tinged with contempt, while industry for the most part ignored the existence of science. To-day we find some 50,000 scientists contentedly domesticated in the 2,000 industrial research laboratories of this country, while industry, with considerable assiduity and often with generosity, caters to their peculiar needs.

In bringing about this startling change in four decades, I believe our laboratory, as a pioneer in industrial research, has been a contributing factor.

I think the hesitation which was manifested by both Dr. Whitney and myself on embarking on industrial research was symptomatic of the general attitude of scientific men. That hesitation in my case was caused not at all by any such feeling as was then entertained by many scientists that science would be soiled by close industrial contacts, but simply by my doubt that industry could present such fascinating problems as lay before me at M. I. T., or problems which would offer equal opportunity for worth-while work. The same was true with Dr. Whitney, I am sure. Indeed he had already made an application of his experimental work to profitable industrial ends. But he too evidently doubted if industry could offer enough problems of interest to occupy his full time to advantage, for he at first arranged to divide his time between Schenectady and Boston. It was not many months, however, before he realized that in the General Electric Company were enough interesting problems to keep himself and a growing staff of assistants busy for a lifetime and more, so he ended his connections with M. I. T. and devoted all his energies thereafter to building up the Research Laboratory here.

My own experience was similar. I was persuaded by Dr. Whitney to join him only by his invitation to bring with me the apparatus with which I was then working at M. I. T. and his assurance that I would be given all the time to devote to it that I desired. But I too soon found more engrossing problems here, so I shipped my apparatus back to Boston, leaving further experiments with it to other hands.

It was not long before the results of our laboratory's work began to appear in the products of the company, in new materials, more efficient processes and new devices, some of them opening up wholly new fields for electrical development. Other pioneer laboratories in their different fields were similarly demonstrating the utility of research in industrial problems, and as papers were read at meetings of the scientific societies, presenting the problems that had been met, their solutions through applied research and the value of the outcome to the public, scientists in general came to realize that there was a tremendously worth-while job for science to do in promoting the nation's industrial progress.

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[1] Address given on December 17 at a dinner on the occasion of the celebration of the fortieth anniversary of the founding of the laboratory.

At the same time, I think, the supercilious aversion on the part of some scientists to industrial contacts faded out. It was at one time a very real thing. Hardly a quarter century ago, thirteen or fourteen years after our laboratory was started, there was another General Electric laboratory in another city which was headed by a scientist obsessed with that aversion in extreme form. His laboratory had accumulated some data which might be helpful in a development of ours, so a letter was written asking for them. His reply was that he feared we contemplated making use of those data in some commercial development, and in that case he would be unwilling to give them to us. I don't know whether he had time to change his attitude toward commercialism, for his association with industry was rather brief.

If there is a scientist to-day who regards industry as barren of interesting problems or contaminating in its contacts, he must be a rare bird, for I do not know one of his species.

Meanwhile industry's attitude to science has been undergoing a change equally profound. During the first fifteen years of our laboratory's existence, the relatively few companies maintaining research laboratories were accumulating proof of their value, but it took the experience of the last war to bring home to American industry what industrial research really means. When the British fleet took its strangle-hold on German commerce, our industries were forced to realize how dependent they had become on the output of German laboratories. Dyes, anesthetics and other essential drugs, optical glass, chemical reagents, magnesium metal and powder and many special alloys were no longer obtainable. American research mobilized to supply the lacks, and, when the United States entered the war, made very important contributions to the national defense. Had it not been for the few industrial research laboratories then in existence, and the university scientists who volunteered or were drafted for the emergency, American industry would have been in worse straits and our Army and Navy would have lacked some of their most effective defense facilities.

While the lessons of the war were fresh in the American mind, the National Research Council undertook to drive home the implications of those lessons, to make industry research-conscious, and to advise in the organization of research, both by the larger individual companies and by industries when the companies composing them were small.

In consequence there are now nearly two thousand industrial research laboratories, and organized research has come to be accepted by industry as an essential activity, as necessary for progress and prosperity as financial control and accounting.

A comparison of conditions to-day with those of forty years ago reveals a change which is fairly revolutionary. The leaders in the revolution were those companies which pioneered in research. But their leadership would have been ineffective, if they had not been able to demonstrate to science and industry alike that industrial research could be a plentiful source of both scientific and industrial progress. The creation of the research era of American industry required more than the fiat—let there be industrial research. Laboratories had to be so organized and directed that the scientist would find in them opportunity for the full exercise of all his ability, and problems calculated to arouse his enthusiasm and inspire his best efforts, while at the same time the industrialists must be able to derive from them products which would increase business and profits. To accomplish such a fusion of the scientific spirit with the profit motive, to inspire enthusiastic team-work within the laboratory, while knitting the laboratory's work, through full cooperative effort, into the company's organization with its diverse activities of engineering, manufacture and sales, required leadership of a new and different kind. The success of an industrial research laboratory in its early years depends almost wholly on the quality of its leadership.

Those of us who have been long in the laboratory and can remember the difficulties under which we often labored in its early years, the frequent failures and disappointments, remember also the sympathetic encouragement, the infectious enthusiasm, the resourceful suggestions and the unflagging assistance we derived from our leader.

And so to-night, thrilled as we have been by the kindly tributes to our laboratory and its achievements, we realize with gratitude and affection how much of the credit should go to our laboratory's founder and builder, Dr. Whitney.

OBITUARY

RAYMOND PEARL

RAYMOND PEARL possessed, to an exceptionl degree, knowledge, originality and an intellectual drive which were a stimulus to all who had contact, either directly or indirectly, with the products of his mind. A pioneer in the application of quantitative methods in biology, he gave great impetus to the development of this field, both through his own extensive research and through the training of students. His sudden death on November 17 cut short an extraordinarily productive career, the influence of which has been world-wide.

Born in Farmington, New Hampshire, June 3, 1879, Raymond Pearl received his undergraduate training at Dartmouth College with the class of 1899, and his graduate training at the University of Michigan, obtaining his doctorate in biology in 1902. He was married in 1903 to Maud M. DeWitt of Sandusky, Ohio, who was also a biologist and became an active collaborator in Dr. Pearl's work. Two daughters, Ruth DeWitt (Mrs. G. P. Jencks) and Penelope Mackey, were born to them.

Dr. Pearl remained with the University of Michigan as instructor in zoology for four years after taking his degree, the last year of this period being spent in study at Leipzig, the University College at London and the National Zoological Station at Naples. In London he studied with Karl Pearson at the Galton Laboratory, and this contact with the new field of biometry and the active minds that were developing it had a profound effect on the future direction of Dr. Pearl's career. His interest in quantitative studies in biology had, however, been evidenced before his London experience, for as early as 1901 he had done research on variation of fishes while working with the U. S. Fish Commission on a biological survey of the Great Lakes.

Returning to this country, Dr. Pearl spent one year as instructor in zoology at the University of Pennsylvania and then became biologist and head of the department of biology at the Maine Agricultural Experiment Station, a position which he held until 1918, when he came to The Johns Hopkins University. His principal studies at Maine were in connection with poultry and they covered many problems of fundamental importance in genetics, disease, and population aggregates. Two books written during this time (with F. M. Surface and M. R. Curtis), "Poultry Diseases and Their Treatment" (1911) and "Diseases of Poultry" (1915), greatly advanced the concepts in this field and have served as a guide to subsequent work along this line.

Following the war, in which Dr. Pearl acted as chief of the statistical division of the U. S. Food Administration, he became a professor at The Johns Hopkins University where he remained until his death. In 1918, the School of Hygiene and Public Health was established at this university and Dr. Pearl was appointed its first professor of biometry and vital statistics, a position which he held until 1925. The breadth of his academic activities is indicated by the fact that he served the university in the following positions: As director of the Institute of Biological Research and as research professor in the School of Hygiene and Public Health from 1925–30; as statistician for The Johns Hopkins Hospital from 1919 to 1935; as professor of biology in the School of Medicine from 1923 until his death; as professor of biology in the School of Hygiene and Public Health from 1930 to his death.

His greatest interest through this career at The Johns Hopkins University was in the quantitative approach to the biology of man and of other animals in population aggregates. A vast amount of material collected by Dr. Pearl and his coworkers through field studies, hospital records, experimental studies, vital statistics reports and other published works, were analyzed for their quantitative relationships in inheritance, longevity, reproductive patterns, growth, population size and vitality. It is impossible to cover in a brief space the colossal amount of work Dr. Pearl accomplished in both the collection of data and their analysis during the past twenty years. Seven of his books, written during this period, present some of the results of this endeavor, and their titles indicate the range of his interests: "The Biology of Death" (1922); "Studies in Human Biology" (1924); "The Biology of Population Growth" (1925); "Alcohol and Longevity" (1926); "The Rate of Living" (1928); "Constitution and Health" (1933); "The Ancestry of the Long-Lived" (with Ruth D. Pearl) (1934); "The Natural History of Population" (1939). In addition to these books in the field of human biology, Dr. Pearl also wrote a text-book entitled "Introduction to Medical Biometry and Statistics," the first edition of which was published in 1923, and the third, a complete revision, in 1940. All of these books, as well as his numerous contributions to scientific journals, contained new ideas which were out of the general pattern, and were provocative of thought and discussion. As is always the case with the output from such a mind, his work challenged and met opposition, and thus demanded careful evaluation of data, and clear statement of hypotheses. Its value lies, therefore, not alone in the share it has given to the present accumulation of scientific knowledge, but also in the spur that it has been to the thinking of workers in science.

The two scientific journals which Dr. Pearl established, *Quarterly Review of Biology* and *Human Biology,* fill a very unique place in the scientific literature. His editorial work in these journals had been shared by Mrs. Pearl, who is now assistant editor of the former and managing editor of the latter. Dr. Pearl also had acted as associate editor of seven other journals in this country and abroad.

The recognition which Dr. Pearl received throughout his career came from so many sources that it is not possible here to present a list of the numerous honors accorded him. He was a frequently sought lecturer, the recipient of honorary degrees from three institutions, a member and fellow of many scientific and honorary societies in this country and abroad. He served at some time as president of a number of these societies, on the council of the National Academy of Sciences and on the executive board of the National Research Council.

One of the founders of the International Union for the Scientific Investigation of Population Problems, Dr. Pearl served as its first president. He gave a great impetus to a movement that has turned serious thought to problems of the utmost importance to students of social trends.

Dr. Pearl was a very wide reader, and the enjoyment and profit which he found in his general reading was evidenced in his book "To Begin With" (1927) in which he made an appeal, particularly to graduate students in science, to discover for themselves the satisfactions to be gained through reading.

In music, also, Dr. Pearl found especial satisfaction, devoting much of his meager leisure to it. Brought up in a musical family, he had at one time or another played most of the wind instruments, and after coming to Baltimore in 1918, he undertook to master the difficulties of the French horn. He became very proficient and for many years had played in two amateur musical clubs of which he was a member.

For a person of Dr. Pearl's enormous activity, it is perhaps fitting that he should stop in the midst of things. His work, however, has not come to an end, for within the university which he served, to the students whose minds he stimulated and in the scientific world to which he made such vast contributions, his influence will continue indefinitely.

Lowell J. Reed

School of Hygiene and Public Health,
The Johns Hopkins University

SCIENTIFIC EVENTS

DAMAGE FROM BOMBS TO THE ROYAL BOTANICAL GARDENS AT KEW[1]

It is so long since I have heard anything from you, or you from me, that I know you will be very grieved to hear how greatly Kew has suffered from enemy action.

Several high explosive bombs have dropped in the Gardens, as well as oil bombs and incendiary ones. Until recently we had not suffered very much damage, as the big bombs which fell were in the far parts of the Gardens. One fell at the north end of the Rhododendron Dell, where it only rooted up a few ordinary Rhododendrons and, of course, made a huge crater. The others fell in grassy spots in the Queens Cottage Grounds and made craters some 25 feet across, but did no damage otherwise, and the oil and incendiary bombs fell on lawns in various places and did no particular harm. A few days later some 6 smaller bombs were dropped near the Isleworth Gate and some were also dropped in the Sion House Meadows across the river. These damaged a good many trees. Some three weeks ago, however, a bomb fell on a house in the Kew Road, close to the Cumberland Gate, and very much glass was broken in Museum No. 1 and in the Orchid Houses, the Sherman-Hoyt House and other places. A bomb which fell on the other side of the river, at Brentford, caused a good deal of damage to the Herbarium, as the blast broke about 100 panes of glass in the middle wing, and a bomb which fell at the foot of Kew Bridge, on our side, broke much glass in No. 4 Museum and in most of our houses along the Kew Road.

Our worst damage unfortunately took place about a week ago when a bomb fell in the early morning in front of a house in the Kew Road, near the North Gallery. The blast from this blew down some 60 yards of our boundary wall and did much damage to the North Gallery and the two adjoining houses in the Gardens. The pictures in the North Gallery, however, had all been removed some time previously to a place of safety. The blast from this bomb also smashed thousands of panes of glass on the east side of the Temperate House, and I fear it will be impossible to repair the damage and should there be a bad winter, no doubt many of the fine specimens will perish. About the same time another bomb fell between the Palm House and the Azalea Garden and destroyed a number of interesting trees in the Ash collection and the blast smashed many hundred panes of glass in the Palm House itself and in the Water Lily House. Here again it will be very difficult to effect repairs and save some of our unique plants, but I am hoping that we shall be able to make sound the southern end of the Palm House, where magnificent Cycad specimens are housed. On the evening of the same day, three bombs fell again near the Temperate House, one in the Heath Garden to the West of King William's Temple, where many interesting Chinese Rhododendrons, Arbutus and other plants were smashed to atoms, and the blast from this bomb broke much more glass in the northern end of the Temperate House. An oil bomb fell close to the Temperate House, but as this smashed a water main, no particular damage was done. The third bomb was a delayed action one, and this I am glad to say has been safely removed before it exploded. It was found to be some 16 feet down and was about 500 pounds in weight. Since then I am glad to say we have not suffered, though several bombs have fallen to the south of us in the Old Deer Park.

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[1] Dr. E. D. Merrill, Director of the Arnold Arboretum, submits this private letter, recently received from London, indicating the extent of damage to the Royal Botanic Gardens at Kew from indiscriminate bombings. The Director of the Royal Botanic Gardens is Sir Arthur Hill, recently honored by being awarded the George Robert White Medal of the Massachusetts Horticultural Society.

I am hoping it may be possible to find accommodation for some of our rarer plants from the Palm House and Temperate House in some place of safety. We are also taking steps to move some of the Herbarium specimens, but with the indiscriminate bombing which is taking place, it is very difficult to find any place which may be safe from enemy attack.

I know that you and other kind friends in America will be very much distressed to hear how Kew has suffered from enemy action, and I much hope that we may be left in peace and that we shall suffer no further damage, as there is no sort of military objective anywhere in this part of the world.

Your sympathy and help are very much appreciated by all of us.

ENGINEERING DEFENSE TRAINING

Dean S. C. Hollister, of the College of Engineering, Cornell University, has been appointed regional adviser for the State of New York outside New York City on the new national program for Engineering Defense Training. Congress recently appropriated $9,000,000 for special engineering courses at the college level, to be given at government expense. The objective is to train 30,000 students with technical backgrounds to meet future needs of both industry and government in carrying out the defense program.

According to the statement from the Office of Education in Washington, "Courses of study will be given by the colleges both for those able to devote their entire time to preparation for future defense jobs and for workers now employed who desire to fit themselves for more responsible assignments. All instruction will be of college grade equivalent to that given regular candidates for a degree, but the special courses, which will require from two to eight months of study, will concentrate upon training of immediate practical application to specific defense jobs. Classes will be held both at the engineering schools and in or near industrial plants for the benefit of part-time and evening students. The regular college teaching staffs will be supplemented by additional teachers including specially qualified men from the industries to be served."

Dean Hollister for several weeks has been in constant touch with state schools involved: Clarkson College of Technology, Rensselaer Polytechnic Institute, Union College, Syracuse University, the University of Rochester and the New York State College of Ceramics at Alfred, in addition to Cornell University. In this program, he acts as a liaison officer maintaining continual contact with defense industries, Army and Navy district offices, employment services and other sources of information on personnel needs, as well as with local engineering schools equipped to meet demands for training courses as they arise. He is keeping the Washington headquarters continually informed so that deficiencies in any one region may be met, if necessary, by training students in other places where facilities are available.

A survey of the needs of industries in Southern Tier counties of New York State, where courses might be offered by Cornell University, has been made by the College of Engineering. Courses will be set up as rapidly as possible.

THE SCIENCE CARAVANS OF THE GENERAL MOTORS CORPORATION

Alfred P. Sloan, Jr., chairman of General Motors Corporation, has announced the dedication of two science caravans " to the vital task of arousing the nation to the necessity of intensifying its research activities." He points out that "the hope of America, in time of emergency as in time of peace, lies in the retorts and test tubes of its laboratories." Both caravans will start within the next few weeks.

Mr. Sloan, in his announcement, writes:

> Our decision to send forth the ''New Parade of Progress'' and the ''New Previews of Progress'' to spread the gospel of research is, we are convinced, eminently sound. Only a cursory glance at what is taking place in the world to-day is needed to impress on one the importance of constant search for new products and processes.
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> And new products and processes will be equally important to take up the slack of men, money and materials when our present emergency shall have ended. As a nation we should be spending ten—even one hundred times as much as we do for research.

The two General Motors shows, presented without charge to the public, will demonstrate not only what industrial research and engineering have accomplished, but also what may be expected from the laboratories of the future if America takes advantage of its opportunities.

The Parade of Progress will be presented out-of-doors, while the Previews of Progress is designed for indoor performances. Both will reproduce the highlights of the General Motors exhibits at the New York and San Francisco World's Fairs. They were designed and constructed under the general supervision of Dr. Charles F. Kettering, vice-president in charge of research, and will be sponsored by the Department of Public Relations, which is in charge of Vice-president Paul Garrett.

The Parade, with fifty young technicians, will go to the larger cities of the south; Previews of Progress, with a personnel of seven trained young men and designed for performances in schools and halls, will go to the smaller cities in the west.

The Parade of Progress will travel in a caravan of twenty-two streamlined, silver-red "Futurliner" transports and tractor semi-trailer units. It includes a tent that will seat 1,500 persons, all with unobstructed views of the "science circus" stage. Colored fluorescent tubes will illuminate the interior; the exterior will be flood-lighted in color. It will include a small sample section of the General Motors Futurama, exhibited at the New York World's Fair; a diorama dramatizing improvements wrought in an American community by steadily bettered roads and vehicles; an exhibit contrasting past and future American home interiors; a series of dioramas picturing the small beginnings of great American industries; an outdoor stage demonstration of paradoxes of friction and of the elasticity of materials; a display of aviation progress; exhibits portraying progress in glass-making, coachcraft, gasoline and scientific automotive service. Some of these exhibits will be completely automatic in motion and sound; others will be in charge of demonstrator-commentators.

Light and power for the entire exposition will be supplied by a specially designed and constructed Diesel-electric plant, said by Mr. Kettering to be "one of the most complete mobile power plants in existence."

THE FORTIETH ANNIVERSARY OF THE RESEARCH LABORATORY OF THE GENERAL ELECTRIC COMPANY[1]

FORTY years ago E. Wilbur Rice, Jr., at that time vice-president of General Electric Company in charge of engineering and manufacturing, received a visit from two men, one an engineer and the other an attorney. They suggested the company should have a laboratory. There had been a problem in Mr. Rice's mind since Edison's famous lamp patent expired six years previously that something should be done to improve the lamp; but how to go about it had not been decided.

Perhaps here was the answer. So Mr. Rice listened as Albert G. Davis, then head of the patent department, and Dr. Charles P. Steinmetz explained their idea of a laboratory where scientific investigations might go forward on the incandescent lamp and other problems. "But these things can't go on without research," Mr. Davis declared.

Research! It was what Mr. Rice himself had been thinking of. Yet hardly another executive in the country in those days had considered such a step. In the discussion that followed all three men agreed that the laboratory should be entirely separate from the factory and sales branch of the company.

"The company spends thousands of dollars and its best brains in trying to add one half of one per cent. to the efficiency of the generator and transformer, yet this current so carefully generated, transformed and transmitted is sent into the lamp with an efficiency of something like five per cent. or less," Mr. Davis told Mr. Rice.

The ultimate result was that Mr. Rice's recommendation to the board of directors was approved without comment other than that Mr. Rice should exercise care in getting the right man to direct the laboratory. Dr. Willis R. Whitney, at that time a professor at Massachusetts Institute of Technology, was engaged. That was forty years ago, and on Tuesday, December 17, this notable anniversary was celebrated by General Electric, with a program beginning in the afternoon and culminating in the evening with a dinner at the Mohawk Golf Club. The speakers were Dr. Karl T. Compton, president of the Massachusetts Institute of Technology; Charles E. Wilson, president of General Electric, and Samuel Ferguson, president of the Hartford Electric Light Company, who was the first engineer of the General Electric laboratory, and Dr. Coolidge, vice-president of the company and director of the laboratory.

The laboratory had its beginning in Dr. Steinmetz's barn in the rear of his home in Schenectady. The house still stands, but the barn was burned soon after its use as a laboratory. Dr. Whitney came over three days a week to carry on experiments with Steinmetz and the "staff," which at that time consisted of one man, J. T. H. Dempster. After the fire, the laboratory was moved to a one-story frame building in the plant of the company which had been built two or three years earlier for a standardizing laboratory, but which had been discarded when this work was moved into a newer building. The structure was used until the spring floods in 1901 when the research laboratory was moved again, occupying the front part of the new standardizing laboratory. In 1904 it moved to a building of its own, adjoining, and later into its present home, two massive brick buildings.

From Dr. Steinmetz's barn to its present two large buildings in forty years—that is the story of the growth of research in General Electric Company.

THE NATIONAL DEFENSE RESEARCH COMMITTEE

ONE of the guiding principles of the National Defense Research Committee is to distribute the burden of research on problems of national defense in such a way as to cause the least possible interference with research already under way for the military services. With that in mind the committee has endeavored to arrange for research to be done wherever practical in institutions which had not already been engaged in research efforts connected with national defense. Obviously in the application of this principle care must be taken that progress is not delayed. Where one organization is outstandingly qualified to conduct a particular piece of research, the problem is turned over to that organization even though it may have other defense research work under way. On the other hand, as between two or more organizations approximately equally well qualified to engage in a particular piece of research, preference is given to that organization which does not have other defense research activities under way.

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[1] A statement from The General Electric Company.

Thus far, the National Defense Research Committee has authorized 126 separate contracts with a total of 51 different academic and industrial establishments. Of this total, 80 contracts are with 32 different academic institutions and 46 with 19 different industrial concerns.

The order establishing the National Defense Research Committee states that its purpose shall be to correlate and support scientific research on mechanisms and devices of warfare except those relating to problems of flight included in the field of activities of the National Advisory Committee for Aeronautics. It may conduct research for the creation and improvement of instrumentalities, methods and materials of warfare. The committee has recently adopted the following resolution as a general indication of the limits of its activity:

> The National Defense Research Committee, by reason of the order of the Council of National Defense which established it, is concerned with scientific research on and development of new instrumentalities or materials of war, or of new materials or methods to be used primarily in the manufacture of instruments of war; and of the improvement of existing instrumentalities or materials of war, or of existing material or methods to be used primarily in the manufacture of instruments of war. Where a material or method is widely used or useful in industry, in addition to its use in the manufacture of instruments of war, as for example in the case of substitute materials of wide utility, the research and development involved do not lie within the province of the National Defense Research Committee, but rather within the province of many existing industrial and scientific research agencies, and in particular, when appropriate requests for investigation or research in such fields are made by government agencies, within the province of the National Academy of Sciences and the National Research Council.

COMMITTEE ON FOOD AND NUTRITION OF THE NATIONAL RESEARCH COUNCIL

At the request of Miss Harriet Elliott, head of the consumer division of the Advisory Commission to the Council of National Defense, the National Research Council of the National Academy of Sciences has organized a committee to promote the development and application of nutritional science. A national program for improving nutrition is in the planning stage under the immediate direction of Director M. L. Wilson, of the Extension Service of the Department of Agriculture, and in this program the Committee on Food and Nutrition of the National Research Council is expected to play an important part. The membership of the committee includes physicians, biochemists and representatives of home economics, dietetics, agriculture and industry. A group of consultants and representatives from governmental services with nutritional responsibilities are associated. It is anticipated that the work of the committee will have a bearing upon the national welfare not only for the time of the present emergency, but in later years as a continuing agency. The committee is organized under the Division of Biology and Agriculture, the Division of Medical Sciences and the Division of Anthropology and Psychology.

The membership of the committee is as follows:

Executive Committee: Russell M. Wilder, *Chairman;* Helen S. Mitchell, *Secretary;* George R. Cowgill; Icie Macy Hoobler.

Members: John N. Black, Henry Borsook, F. G. Boudreau, Joseph S. Davis, C. A. Elvehjem, Philip C. Jeans, Norman Jolliffe, C. G. King, James McLester, S. C. Prescott, Lydia J. Roberts, W. C. Rose, Cullen Thomas, R. R. Williams, John B. Youmans.

Government Representatives: Grace Bulman, William DeKleine, Martha M. Eliot, J. K. Fuller, Colonel Paul E. Howe, E. M. Nelson, W. H. Sebrell, Louise Stanley, Commander Charles S. Stevenson.

Consultants: E. V. McCollum, John R. Murlin, Mary Swartz Rose, H. G. Sherman.

Ex Officio: Robert F. Griggs, *Chairman*, Division of Biology and Agriculture; Lewis H. Weed, *Chairman*, Division of Medical Sciences; Carl E. Guthe, *Chairman*, Division of Anthropology and Psychology; M. L. Wilson, National Defense Nutrition Program.

SCIENTIFIC NOTES AND NEWS

Dr. Harry N. Holmes, head of the department of chemistry at Oberlin College, Ohio, has been elected president of the American Chemical Society for 1942. Dr. Holmes will take office as president-elect on January 1 at which time Professor William Lloyd Evans, head of the department of chemistry at the Ohio State University, becomes president of the society, succeeding Dean Samuel Colville Lind, of the University of Minnesota.

At a meeting in New York on December 20 of the fellows of the American Geographical Society, the

Cullum Geographical Medal was presented to Dr. Robert Cushman Murphy, curator of oceanic birds at the American Museum of Natural History; the Charles P. Daly Medal, "for valuable or distinguished geographical services or labors," was presented at the same time to Professor Carl Ortwin Sauer, head of the department of geography of the University of California in recognition of "his outstanding contributions to geography as a teacher and research scholar." The inscription on the medal to Dr. Murphy was "Robert Cushman Murphy—by following the sea birds to their haunts he has deepened our knowledge of the world of waters."

SIR ARTHUR KEITH, master of Buckston Brown Research Farm at Downe, anatomist and anthropologist, was elected an honorary member of the New York Academy of Sciences at the annual meeting of the academy, held in New York on December 11.

DR. FRED H. ALBEE, president of the International College of Surgeons, formerly professor of orthopedic surgery at the New York Postgraduate Medical School, received a bronze plaque designating him "the Man of the Year" for 1940 from the Greek letter fraternity, Kappa Sigma, at the annual Founders Day banquet held in Washington on December 10. The award was made in recognition of his achievements on bone graft surgery and in rehabilitation work.

W. D. COOLIDGE and Stuart M. Crocker have been appointed vice-presidents of the General Electric Company. Dr. Coolidge will continue as director of the research laboratory in Schenectady. Mr. Crocker will relinquish his work as manager of the department of air-conditioning and commercial refrigeration of the company at Bloomfield, N. J., and will make his headquarters in New York City, where he will cooperate with and be assisted by all commercial departments in furthering the general interests of the company.

THE Scientific Society of San Antonio, Texas, at its thirty-sixth annual meeting, elected as president Colonel W. Lee Hart, Medical Corps, United States Army, now serving as chief surgeon of the Eighth Corps Area.

THE Detroit Academy of Natural Sciences has elected the following officers for 1941: *President,* Robert T. Hatt; *Vice-president,* Bert Hudgins; *Secretary,* Bert Lambert; *Treasurer,* Fred Robinson; *Member of the Council,* George Rawson.

OFFICERS for the coming year of the Botanical Society of Washington have been elected as follows: *President,* J. E. McMurtrey, Jr.; *Vice-president,* Victor F. Tapke; *Recording Secretary,* L. Edwin Yocum; *Corresponding Secretary,* Marguerite S. Wilcox; *Treasurer,* Harvey L. Westover; *Counsellors,* John R. Magness, Earl S. Johnston; *Representative to the Washington Academy of Sciences,* Melvin C. Merrill.

THE board of governors of the Society of the New York Hospital has elected William Harding Jackson, member of the law firm of Carter, Ledyard and Milburn, president of the society. He succeeds Berklie Henry, president for the past two years, who was elected vice-president. Augustine J. Smith, senior member of the board and a governor for thirty-eight years, was reelected secretary. Henry S. Sturgis, vice-president of the First National Bank, was reelected treasurer.

HOWARD R. BARLOW, associate professor of aeronautical engineering, of the University of Minnesota, who has been acting head of the department this summer during the absence of Professor John D. Akerman, has been made head of a new department of aeronautical engineering at the Texas Agricultural and Mechanical College Station.

BURGESS H. JENNINGS, of Lehigh University, has been appointed professor of mechanical engineering at Northwestern University; Carl C. Branson has been appointed visiting assistant professor of geology and geography.

DR. MICHAEL PEECH, chemist at the Florida Citrus Experiment Station, has been appointed assistant professor of agronomy in the New York State College of Agriculture of Cornell University to fill the position held by Professor Benjamin D. Wilson, who died on September 5 of injuries suffered in an automobile accident.

DR. ROBERT D. DEFRIES has been appointed director of the School of Hygiene and of the Connaught Laboratories of the University of Toronto. During the past twenty-five years he has been engaged in the work of these two institutes, having early in 1915 become actively associated with the late Dr. J. G. FitzGerald, whom he now succeeds.

DR. MAX TRUMPER, chief of the department of biochemistry and toxicology of St. Luke's and the Children's Hospital, Philadelphia, has been elected a member of the Board of Trustees of the National Farm School at Doylestown, Pa.

ACCORDING to *Nature* the following appointments have recently been made in the British Colonial Service. P. R. Akehurst, agricultural officer, Nyasaland; L. H. Browne, agricultural officer, Nigeria; J. W. D. Goodban, agricultural officer, Nigeria; A. P. MacWilliam, agricultural officer, Trinidad; D. B. Murray, agricultural officer, Nigeria; P. Paine, agricultural officer, Nigeria; M. F. H. Selby, botanist, Nigeria; N. Harris, geologist, Uganda.

Dr. Henry K. Svenson, curator of the herbarium at the Brooklyn Botanic Garden, sailed for Ecuador on December 20. The recipient of a fellowship from the Guggenheim Foundation, Dr. Svenson plans to study the plants on the coast of Ecuador and determine what relation they may have to the plants of the Galapagos Islands. He expects to be absent for about four months.

Dr. Cornelius P. Rhoads, director of the Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York, has been appointed a member of the National Advisory Cancer Council for a term of three years. The council cooperates with the federal government in the treatment of cancer throughout the country and in research and education to combat the disease.

Dr. Erhard Fernholz, chief of the Division of Chemistry at the Squibb Institute for Medical Research at New Brunswick, N. J., disappeared on December 14. It is reported in the press that the Federal Bureau of Investigation has not been able to find any clue.

Dr. E. A. Doisy, professor of biological chemistry and director of the department of chemistry at the School of Medicine of St. Louis University, has presented the first lecture under the Julius Stieglitz Memorial Lectureship at the University of Chicago. The lectureship was established through joint effort of the Chicago Section of the American Chemical Society and alumni of the department of chemistry of the University of Chicago.

Dr. Lancelot Hogben, of the University of Aberdeen, at present guest professor of genetics at the University of Wisconsin, spoke at the Iowa State College on December 13 on "Recent Developments in the Evolutionary Theory" and on "Methods and Problems of Human Genetics." The latter lecture was given at a meeting of Sigma Xi.

Dr. Isaac Starr, Hartzell professor of research therapeutics at the University of Pennsylvania, gave on November 13 the fourth annual Paul Reed Rockwood Lecture of the College of Medicine of the Iowa State University. His subject was "The Ballistocardiogram; Its Contribution to Our Knowledge of the Commoner Diseases Affecting the Heart and Circulation."

Dr. Frank H. Lahey, director of surgery at the Lahey Clinic, Boston, president-elect of the American Medical Association, formerly professor of surgery at the Medical School of Tufts College, delivered the second Floyd Wilcox McRae Memorial Lecture on December 16, before the Fulton County Medical Society, Atlanta. His subject was "The Management of Gastric, Duodenal and Jejunal Lesions."

J. D. Bernal, associate director of research in crystallography at the University of Cambridge, gave an address on "The Physics of Air-raids" at the Royal Institution, London, on December 3.

The American Mathematical Society is endeavoring to increase interest in questions of the application of mathematics by special lectures and symposia designed for engineers and applied mathematicians and intended to call the attention of pure mathematicians to problems in the applied field. As the initial lecture in this connection, it is planned to have Dr. C. Rossby, of the U. S. Weather Bureau, speak at the joint meeting of the society and the American Association for the Advancement of Science in Philadelphia at Christmas time. His subject will be "The Mathematical Problems in Meteorology." At the February meeting of the society, it is planned to devote Friday afternoon to applied mathematics. First, there will be talks by Dr. W. A. Shewhart, of the Bell Telephone Laboratories, on "Statistics" and by Professor J. J. Stoker, of New York University, on "The Mathematical Problems Connected with the Buckling of Elastic Plates." Further lectures of this type are planned for future meetings.

The Hoffmann Scholarship of the Chemists' Club, established by the late Dr. William F. Hoffmann, will be available for the school year 1941–42. Candidates are limited to men entering the last year of post-graduate work leading to the Ph.D. degree in chemistry or in chemical engineering in an institution of recognized standing. Applications will be considered after January 1, but will not be accepted after April 15. Harvey H. Grice, a candidate for the Ph.D. degree in chemical engineering at the Ohio State University, has been awarded the Bloede Scholarship of the club for the school year 1940–41. This scholarship, which was founded in 1916 by the late Dr. Victor G. Bloede, was originally given every year. Appointments are now to be made in alternate years; the stipend is $560.

Two graduate fellowships in chemistry have been established at the University of Buffalo by the Buffalo Electro-Chemical Company. The fellowships will provide the holders with $1,000 each for the academic year. During his tenure each fellow will be engaged in research work under the supervision of the department of chemistry and will be a candidate for the degree of doctor of philosophy.

The Iowa State College has received a farm and a gift of $10,000 from Rollins E. Hinds, of Ottumwa. On accepting the gift, the Board of Education established the Hinds Fund for Agricultural Research. This fund will be used, in cooperation with the Soil Conservation Service, for the study of soil erosion.

THE California Commission, a body created by the governor of the state to aid the recent Golden Gate Exposition, has presented exhibits valued at $80,000 to the University of California. Among exhibits sent to other institutions, two went to the Buffalo Museum of Science in Buffalo, N. Y. These were the Demonstration of Human Heredity and the Migration of the Races of Man. The Museum of Science and Industry in Chicago received the model of the San Francisco-Oakland Bay Bridge. The Griffith Observatory, a part of the Los Angeles City Park System, received the exhibit on Nuclear Charge, otherwise known as the Soap Bubble Gun, and Stanford University acquired the exhibit of the Embryology of the Salamander, which was prepared in cooperation with Dr. V. C. Twitty, of that university.

IN an article in *Industrial Standardization* R. P. Anderson, chairman of the American Standards Association, states that despite the war situation in Europe, the American Standards Association has continued its support of the International Electrotechnical Commission and also of the International Standards Association. While much of the international work is at a standstill and the future situation is uncertain, it is maintaining contacts with a number of foreign standardizing bodies and continuing to obtain copies of their standards wherever possible. So far, the association has encountered no great difficulty in sending and receiving communications from these groups abroad and its file of foreign standards has been invaluable to American firms filling orders for export. Even the British Purchasing Commission has found it necessary to call on the association on numerous occasions for standards and specifications which they did not have themselves. Recently the American Standards Association has received copies of the second edition of the International Electrotechnical Vocabulary, which is being distributed in the United States.

DISCUSSION

PERCEPTUAL DISORIENTATION DURING LANDING OF AIRPLANE

UNDER the above title in SCIENCE, November 22, A. D. Moore described an illusion which he had noted during landings of airliners, and he raised a question on the possibility of trouble in case a pilot was confronted with unusual conditions that might make him subject to this illusion. Writing partly as a pilot with a thousand-and-some hours, but more as a physicist, I feel sure the illusion will not cause any such trouble, but I should like to add a point to Moore's explanation.

Briefly, the illusion is this: Looking across the ship from a seat in the passengers' cabin, when the ship had "started to skim along the runway," the field "appeared to slope down forward at an angle of about 15 degrees." This illusion continued after the wheels touched the ground, even though Moore turned his head repeatedly between that window and one on his own side, through which the ground "remained horizontal." But, "when the plane, with a low remaining speed, wheeled through a short turn to taxi back, the phenomenon abruptly ceased."

In explanation, Moore notes that during each flight before such an observation he had got accustomed to the fact that the window frame lines were horizontal and vertical, so it was natural to persist in thinking of the horizontal ones as horizontal even when the ground seen through the frames was no longer parallel to them. This is indeed natural, as I can testify in terms of a memory from age 10 or 12, of exploring the hold of a schooner, which had been wrecked on a beach and lay heeled over some 10 or 20 degrees, and feeling seasick, apparently because of the conflict of such evidence with that of my semicircular canals and other internal senses.

There is more to it, however, in my opinion. Airline pilots use their controls and throttles with most expert smoothness. In their hands the ship changes its attitude and its speed with none of the bumps of a railroad train or an automobile. And the cruising speed is so high that in stopping the ship with a backward acceleration of the order of 20 per cent. of gravity there is time to build up this acceleration very gradually and then maintain it for a long time.

Let us apply these principles to the approach and landing. In the straight glide, for perhaps a mile or two, the ship is nosed down and the passenger gets used to the downward slope of the floor and of the "horizontal" frame lines of the windows. The speed is almost constant, the propeller thrust and the forward component of gravity being balanced by the drags of the ship and its flaps, which are usually down for most of this time. Nearing the airport boundary the throttles are closed smoothly, reducing the propeller thrust to zero and thereby introducing a considerable backward acceleration. But during this change the nose is rising and the flight path is becoming more level. So, as the backward acceleration grows, the forward component of gravity fades out. The passenger, however, so long as he keeps his eyes within the ship, has no way to tell backward acceleration from forward gravity. If the changes are smooth enough, and properly correlated as to time and magnitudes, his visual illusion of the cabin as a fixed frame of reference may be corroborated by false evidence from his semicircular canals and all other physiological means of sensing what is horizontal. With all these senses combining to mislead him, it is no wonder that he may discredit the little glimpses of the ground through these small and distant and apparently stationary windows.

After the wheels touch, the aerodynamic drags weaken gradually, but the wheel brakes take their place and the backward acceleration may not change much. So it is reasonable that the illusion should persist sometimes nearly to the end of the run. Then, when the ship wheels around and the engines start up for taxying, the acceleration is quickly changed from backward to forward; so in the cases observed by Moore, "the phenomenon abruptly ceased."

To create this illusion, and to maintain it during the change from aerodynamic drags to wheel brakes, the ship must indeed have to be handled very smoothly. But these airline pilots are smooth!

On the practical question of the possibility of a pilot being misled by this illusion, it must be noted that experienced pilots are already disillusioned as to their sense of level, and they are also well trained on how the ground should look in a landing.

This does not mean any lack of use for the sense of level, but only that its use is not what the layman would expect. The principles applied above, to explain Moore's phenomenon, apply also to turns. In them, centripetal acceleration acts like the backward acceleration in a landing, to mislead our sense of level. The only difference is that in the turn it is not through the side windows, but ahead, that the horizon appears not horizontal. If the ship is correctly banked for the turn, however, she seems level to all senses but that of sight. So the pilot uses his internal senses of level to find the correct angle of bank, well knowing that what he senses is not really level, and he uses his eyes to find the true level.

This separation of the internal and visual senses of level, and their concurrent but independent uses for different purposes, is therefore a very important part of piloting. The ability to separate them has to be acquired in learning to fly, because flight is the only activity in which accelerations can grow so smoothly and with so little angular velocity as not to warn us of the difference between acceleration and gravity. Having acquired this ability, however, and having had to put some real effort into its acquisition, the experienced pilot can be counted on to apply it in landing on any airport that he can see. So there is no appreciable chance of his being misled by Moore's illusion.

DAVID L. WEBSTER

STANFORD UNIVERSITY

SPATIAL DISORIENTATION DURING LANDING FROM AIRPLANE

THE type of spatial disorientation reported by Professor A. D. Moore[1] in connection with the landing of an airplane is by no means unknown to experimental psychologists, although too little attention has been paid to it in the literature on space-perception. The basic principle, as Professor Moore suggests, is that of the conflict of two spatial frames of reference, both of which reside in the visual field of the observer, but one of which is more closely related to the directional system of the observer's body. The ground, as seen through the near window, occupies a sufficiently large visual angle to dominate the perceptual process and consequently to provide a "true" system of horizontal and vertical directions. As seen through the far window it is imbedded in the framework of the interior of the plane, and is consequently seen as tilted. The underlying principles have been discussed, although with different examples, by Koffka,[2] Wertheimer[3] and others, and the phenomenon has even crept into at least one elementary text-book.[4]

Whether or not this is a newly discovered phenomenon is, however, of no importance. What is to be emphasized is that this type of "illusion," and the underlying psychological principles, may too easily be overlooked, not only in aviation but in any field of activity in which the perception of space is an important factor. In seeking for the determinants of our perception of spatial directions we are apt to concentrate on the vestibular functions to the neglect of visual organization. In the example which Professor Moore cites, the problem is essentially visual. I am inclined to think that the solution which he proposes will not prove satisfactory. It might be noted, however, that a sub-committee on problems of perception has recently been organized in connection with the program of the National Defense Research Committee. The problem might well be referred to this committee.

R. B. MACLEOD

SWARTHMORE COLLEGE

THE HEAT OF SEROLOGICAL REACTIONS

THE only attempt to measure directly the heat of an antibody-antigen reaction known to us is that of Bayne-Jones.[1] It is generally admitted that his result is much too high.[2] We have recently completed measurements of the heat evolved when an antigen (hemocyanin of *Busycon canaliculatum*) reacts with an immune serum containing the corresponding antibody. In the region of antibody excess, where no precipitate is formed, a value of about 3.0 calories per gram of antigen nitrogen was found (measured at 31° C.). Since the molecular weight of the antigen is 6,800,000, this corresponds to about 3,300,000 calories per mol of antigen. It is believed that this value is probably accurate to about 20 per cent. By extrapolation from analyses of specific precipitates, it was calculated that the above result corresponds to about 40,000 calories per mol of antibody. The magnitude of the result would presumably be different when the antibody and antigen were mixed in different proportions, and would probably be different for antigens of different molecular weights, on account of the different numbers of specific combining groups. Details will be published elsewhere.

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[1] A. D. Moore, SCIENCE, 92: 477, 1940.

[2] K. Koffka, "Principles of Gestalt Psychology," 1935.

[3] M. Wertheimer, *Zsch. f. Psychol.*, 61: 161–265, 1912.

[4] E. G. Boring, H. S. Langfeld, H. P. Weld, "Introduction to Psychology," 1939.

[1] S. Bayne-Jones, *Jour. Immunol.*, 10: 663, 1925.

[2] F. C. Smith and J. Marrack, *Brit. Jour. Exp. Path.*, 11: 494, 1930.

William C. Boyd

Evans Memorial Hospital,
Boston University School of Medicine

John B. Conn
Donald C. Gregg
G. B. Kistiakowsky
Richard M. Roberts

Harvard University

LINNAEUS ON MAN'S NATURAL HISTORY

I have just received, from Miss R. E. Dosé, from the Department of Agriculture, dated October 23, 1940, the note given below, which may be of general interest. It is an extract from a book containing correspondence of John George Gmelin with Carl Linnaeus and others, edited by Dr. William Henry Theodore Plieninger, and published at the order and expense of the Royal Academy of Sciences of St. Petersburg, Stuttgart, 1861.

On page 55 of this book there is a letter written by Linnaeus to Gmelin from Upsala on February 14, 1747. Here is a translation of a part of this letter:

> It would not please, if I placed the man among the anthropomorphous; but man knows himself. Let us abandon words, I do not care what words we use; but from thee, and from the whole world I want an answer to this: What is the difference between man and ape, difference which would be based on natural history? Most definitely I see no difference. I wish some one could show me even one distinction! Should I call a man "ape" or an ape "man," all the theologians would be after me. Yet, for the sake of science, I should have done it.

Aleš Hrdlička

U. S. National Museum

RESIGNATION OR EQUANIMITY?

The system of weights shared by the English-speaking world is often regarded as a cross to be borne with resignation. In our opinion it should be borne with cheerful equanimity: its minutiae test the memory and sharpen the wit. The table we have prepared may be useful to the student of science who is trained to think in terms of the metric system within the laboratory and in the English system elsewhere. Though not very useful to foreign students visiting our laboratory, this table at least entertains them. They are presented with a copy but are not asked to memorize it.

Ordinary System of Weights

	1 grain (pearls)	50	mg.
1.296 grains (pearls)	= 1 grain (ordinary)	64.8	mg.
3.086 grains (ordinary)	= 1 carat (m.)	200	mg.
1.027 carats	= 1 carat (1877)	205.6	mg.
6.30 carats (1877)	= 1 scruple (apothecary)	1.296	g.
1.200 scruples (apoth.)	= 1 pennyweight (Troy)	1.355	g.
1.140 pennyweights (Troy)	= 1 dram (avoirdupois)	1.772	g.
2.194 drams (av.)	= 1 dram (apothecary)	3.888	g.
7.29 drams (apoth.)	= 1 ounce (av.)	28.350	g.
1.097 ounces (av.)	= 1 ounce (Troy & apoth.)	31.103	g.
12.00 ounces (Troy & apoth.)	= 1 pound (Troy & apoth.)	373.241	g.
1.215 pounds (Troy & apoth.)	= 1 pound (avoirdupois)	453.59	g.
14.00 pounds (av.)	= 1 stone	6.350	kg.
2.00 stones	= 1 quarter	12.701	kg.
2.68 quarters	= 1 flask (mercury)	34.019	kg.
1.333 flasks (Hg)	= 1 keg (nails)	45.359	kg.
1.00 keg (nails)	= 1 short hundredweight	45.359	kg.
1.120 short hundredweight	= 1 long hundredweight	50.802	kg.
1.607 long hundred weight	= 1 small barrel (lime)	81.65	kg.
1.089 small barrels (lime)	= 1 barrel (flour)	88.90	kg.
1.020 barrels (flour)	= 1 barrel (fish)	90.72	kg.
1.400 barrels (fish)	= 1 large barrel (lime)	127.00	kg.
3.571 large barrels (lime)	= 1 kip	453.59	kg.
2.00 kips	= 1 short ton	907.00	kg.
1.120 short tons	= 1 long ton	1016.04	kg.

Inspection shows that with few exceptions the definers of our units have successfully avoided the monotonous uniformity of the metric system by allotting no more than an equitable share of zeroes to the ratios between successive units. In order to bring into line the few exceptions which did slip by we suggest that the simple change of redefining a stone as 13 5/7ths pounds instead of 14 would make the stones and quarters accord more closely with the rest of the system, leaving only the ounces, the keg and the kip to be dealt with.

W. H. Forbes
D. B. Dill

Harvard University

SCIENTIFIC BOOKS

LATTICE THEORY

Lattice Theory. Vol. XXV. Colloquium Publications. By Garrett Birkhoff. v + 155 pp. New York: American Mathematical Society. 1940.

The past decade has seen a tremendous and continuing growth of interest in modern abstract algebra. Algebraic concepts and technique have been found to be frequently applicable to other branches of mathematics as well as other sciences, and their fundamental value has been emphasized thereby.

A major portion of algebraic study has been concerned with mathematical systems consisting of a set of elements which behave with respect to two operations very much as ordinary numbers do with respect to addition and multiplication. In studying subsystems of the same type as a given system one usually considers the meet and join of any two of them, and finds that these are again subsystems of the same abstract type. Thus one may again abstract and study a new type of mathematical system consisting of two operations and a set of elements whose behavior with respect to the operations is now like those of subsystems with respect to meet and join. The application of algebraic research technique to this most recent phase of abstract algebra is a study which has strongly attracted many American algebraists and one of the most prolific workers in the field is Garrett Birkhoff, who has called the subject *Lattice Theory.*

Birkhoff's book is the first comprehensive treatment of the subject and its applications. It contains all the recent major developments in the subject in a unified form which will make the book an inspiring research reference for the relatively large number of research algebraists interested in the field. The exposition is clear and well written and should prove of great value in satisfying the demand of non-specialists in the subject who have been anxious for several years to obtain a text by the use of which it may be possible to present the subject as a graduate course in modern mathematics.

Adrian Albert

The University of Chicago

FORAMINIFERA

A Catalogue of Foraminifera. By Brooks F. Ellis and Angelina R. Messina. 30,000 pp. The American Museum of Natural History. $100.00.

The natural sciences have reached a stage in their development where the scientist is almost buried under the knowledge with which he has to deal. No longer can he make this knowledge usable by merely organizing it. He must now summarize it and catalogue it as well.

The summarizing and cataloguing of man's knowledge of even a relatively small branch of one of the natural sciences, such as a single group of animals, is a laborious task. When the group contains more than 18,000 species the task calls not only for much labor, but for great organizing ability on the part of the scientist and large-scale financial backing by some interested institution or government bureau. Few scientists have had the ambition to plan summaries or catalogues of this scope, fewer still have had the courage and energy to undertake their preparation, and very few, indeed, have had the ability to enlist the necessary financial support and carry the work through to completion. This catalogue is proof, however, that, given the man, such projects can be successfully carried out.

Because of their importance as index fossils in the search for petroleum and for other reasons the Foraminifera have received a good deal of attention from biologists and paleontologists in recent years. Much has been published concerning them in many languages. Some 18,000 living and extinct species have been described. The mere cataloguing of these species must have been a huge undertaking. The preparation of an *illustrated* catalogue was a task on which only a brave and optimistic man would have dared to venture. That Professor Ellis *did* undertake it is proof that he was both courageous and an optimist. That he completed it is proof that he was a practical idealist.

Undoubtedly the most practical thing which Professor Ellis did when he planned this project some ten years ago was to enlist the cooperation of Miss Messina, who shares with him the credit for its successful carrying through. With the generous assistance of the Work Projects Administration, the American Museum of Natural History, Columbia University and New York University, these authors have prepared and issued one of the most voluminous single publications relating to the natural sciences that has ever appeared in print. A staff of 125 artists, bibliographers, editors and other assistants was engaged for six years in the preparation of the manuscript and its printing.

The 30,000 pages of the catalogue contain one or more figures of every species of foraminiferan, living or extinct, a reference to the original description of the species, a transcript of the original description, a record of the time range, type locality and geographic range of each species, the depository of the type specimens and a list of bibliographic references. There are also included a discussion and bibliography of each genus, with a type reference, a transcript of the original description and the name of the genotype when a genotype was designated by the original author. The pages of the catalogue are bound in ledger type post binders to permit future rearrangement and the insertion of additional pages containing descriptions of new genera and species which will be issued by the Department of Micropaleontology of the American Museum of Natural History.

The books are printed on sturdy paper. Their pages will need to be strong if they are to withstand the constant wear which such indispensable reference volumes are sure to receive at the hands of biologists and paleontologists for many years to come.

B. F. Howell

Princeton University

SOCIETIES AND MEETINGS

THE TEXAS ACADEMY OF SCIENCE

On Saturday, November 9, the Texas Academy of Science closed its three-day annual meeting held at the Plaza Hotel, San Antonio. The Texas Federation of Nature Clubs (Dr. Leo T. Murray, of Baylor University, *president*) and the Texas Wildlife Federation (Dr. Walter P. Taylor, of A. and M. College, regional representative, *chairman*) were cooperating organizations. The meetings included fifteen technical sessions, two public general sessions, three business sessions, six luncheons and special dinners and the annual dinner beside the business, technical and social sessions of the Collegiate and Junior Divisions of the Academy. An estimation of attendance places the number of separate individuals who were present at one time or another at well over one thousand.

Speakers following the Thursday dinner were: Colonel H. A. Finch, U. S. A., on the "Science of National Defense," and Dr. Robert Montgomery, of the University of Texas, on "The Effect of Monopolies on Our National Defense Program."

Following the Friday dinner Dean Oscar A. Ullrich, of Southwestern University, president of the academy, presented his presidential address, "The Adolescence of Social Science." He was followed by L. B. Kingman, of the Federal Bureau of Investigation, who spoke on "The Science of Crime Detection."

The Collegiate division of the academy, which consists of student chapters in the various colleges of the state, held three scientific, a business and a luncheon session during Friday and Saturday. About 100 division members attended.

The Junior division, consisting of high-school chapters throughout the state, presents its main program at the regional spring meetings. This is necessitated by the large area of the state. At the annual meeting only officers' conferences, prize and outstanding papers sent in from the preceding regional meetings, and local papers participate. However, twenty-three papers and a division breakfast appeared on the program.

Local colleges, museums and learned societies of San Antonio all participated in forwarding the plans for the meeting and in contributing to success.

There developed a strong movement, in the interests of forwarding some special plans to be announced definitely later, for maintaining a continuity of 1940 plans through 1941, and Drs. O. A. Ullrich, of Southwestern University, Frederick A. Burt, of A. and M. College, Otto O. Watts, of Hardin-Simmons University, and S. W. Bilsing, of A. and M., who served respectively as president, secretary, treasurer, and representative to the council of the A. A. A. S., will continue in their offices until the time of the next annual meeting. Over 100 new members were elected to membership, and 29 members of one or more years standing were by vote transferred to the list of fellows.

Frederick A. Burt,
Secretary

REPORTS

DEFERMENT FROM MILITARY SERVICE OF SCIENTIFIC MEN

The question of deferment from military service of selected men in six scientific fields in industry and educational institutions is the subject of a report in answer to a request of Clarence A. Dykstra, director of the Selective Service System. It is signed by Dr. Isaiah Bowman, president of the Johns Hopkins University, and Dr. Frank B. Jewett, president of the National Academy of Sciences. The report was prepared under the auspices of the National Academy of Sciences and the Subcommittee on Military Affairs of the National Committee on Education and Defense, created jointly by the American Council on Education and the National Education Association.

The report follows:

Both because your letter asks for a prompt reply and because the entire structure of the defense program is not yet sufficiently developed to indicate the full extent to which scientific personnel should be exempted temporarily or permanently from military service, it is impossible at this time to express an opinion as to the whole field of fundamental and applied science.

All that this statement attempts to do therefore is to cover those fields of science in which the conditions seem clearly to indicate the general course that should be pursued in the best interests of the national defense program. As to the other fields of science, supplementary statements may be issued as soon as they can be more thoroughly studied from the standpoint of general procedure. Individual cases for deferment undoubtedly exist in all of them at the present time and more will develop as the defense program expands.

Experience of every nation engaged in the World War and the conditions under which the present conflict in Europe is being waged point directly to the necessity for proper employment of scientific personnel and of those competent to train such personnel, to a continuous supply of newly trained personnel, and to the penalties incident to assigning them in large numbers to purely military service where others without their special training can function equally well.

At the moment, the fields of science in which the present and prospective personnel situation in relation to the needs of the defense program clearly require careful consideration of requests for deferment by both university presidents and heads of industrial laboratories are as follows:

Medicine, dentistry and pharmacy.

Biology, bacteriology and any other branch of biological science which bears directly upon problems of medicine or the public health, safety or interest.

Chemistry.

Physics.

Geology and geophysics, including such specialized fields as meteorology, hydrology and cartography.

Engineering, including civil, electrical, chemical, mechanical, agricultural, sanitary and mining.

You request advice which will be of assistance both to university presidents and heads of industrial laboratories. Their problems of deferment are similar although not identical. The college and university is concerned both with the training of men and in the conduct of fundamental research. The industrial laboratory is concerned primarily only with the conduct of research.

So far as college and university presidents alone are concerned, questions of deferment of both students and faculty are involved in all six fields.

In the training function, the institutions vary as to the extent of specialization in the areas above. Recommendations for deferment should be made for students only in those fields in which the institution is adequately equipped both in personnel and facilities to provide an adequate and comprehensive educational program.

Until July 1, 1941, the situation as to students in science, both undergraduate and graduate, appears to present no immediate problem in view of (4f) of "Selective Training and Service Act of 1940." If further deferment beyond July 1, 1941, for students (particularly graduate) is made possible it may present no special problem.

An exception requiring immediate determination for permanent exemption of students from military field service until after graduation may exist in certain fields, *e.g.*, medicine, dentistry and pharmacy, where there will be large demand for trained men in both the military and civil sectors, and where, because of the character of the training required, a deficiency of supply of qualified personnel can not be made up by intensive specialized training.

Deferment should be requested for advanced undergraduate and graduate students who, in the judgment of the college and university administrators, will be specially qualified to contribute to the defense program if permitted to complete all or a major part of their study before entering the military establishment or a defense industry, or who are required to replenish a depleted instructional staff. Such requests should be on an individual basis and only for those in good standing, majoring in the respective field, and who have completed at least two years of college.

In all six fields university presidents should request deferment of members of the teaching staff who in their judgment are essential properly to maintain the efficiency of the institution in the continuous training of students necessary in the operation of the defense program or in the effective conduct of research and development problems assigned to the institution in connection therewith.

The industrial laboratory and some graduate schools employ trained personnel often in group or team operations which require not only highly skilled individual scientists and engineers but likewise men accustomed to working together in close cooperation. Subtraction of a single key man from such a group may seriously handicap or even substantially destroy the efficiency of the group to function.

The problem of the industrial and university research laboratory concerned with a present or prospective defense program is not only one of retaining an adequate number of highly trained research men, engineers and skilled technicians but also one of maintaining the integrity of research and development teams. This is because industrial research and development is a coordinated group activity.

Research directors should request deferment of highly qualified men whose training and experience are such that their withdrawal will cripple the ability of the laboratory to function effectively in the defense program.

In addition to trained scientists and engineers, the industrial and university laboratory is largely dependent on skilled craftsmen, such as draftsmen, instrument makers, etc. Request for deferment of skilled men in these categories is indicated unless they can be replaced.

FOR THE NATIONAL ACADEMY OF SCIENCES,
FRANK B. JEWETT, *President*
FOR THE SUBCOMMITTEE ON MILITARY AFFAIRS,
ISAIAH BOWMAN, *Chairman*

SPECIAL ARTICLES

A FURTHER NOTE ON THE IDENTITY OF VITAMIN H WITH BIOTIN[1, 2]

In a previous communication[3] we reported that a preparation of crystalline biotin methyl ester possessed vitamin H activity to a very high degree. This observation provided additional and direct support for our earlier conclusion[4] that vitamin H and biotin are "either identical or indeed closely related compounds." The sample employed in the investigation[3] was a solution of 150 γ of crystalline biotin methyl ester in ethyl alcohol that had been kindly furnished us by Professor F. Kögl. This material, which had been isolated from egg yolk, was shown by our assays with the rat curative method to contain 10,000 vitamin H units per mg. We now wish to report confirmation of the vitamin H activity of biotin by assays of crystalline biotin methyl ester isolated by us from a liver concentrate.

The first crystalline product we obtained from the liver concentrate possessed the same crystalline form as reported by Kögl and Tönnis[5] but showed a slightly higher melting point of 154° in contrast to that of 148° reported by them. It also showed a somewhat higher biotin activity (about 20 per cent.) when assayed against the sample furnished us by Kögl. The vitamin H assays, likewise, were proportionately higher. In view of this somewhat higher melting point and activity, we became interested in determining whether further purification were possible.

By repeated crystallization of the compound from a mixture of methanol and ether, a product of constant melting point and biotin activity was obtained which melted sharply in the Kofler micro-melting point apparatus at 166–167° (uncorrected), a melting point 18–19° higher than that reported by Kögl and Tönnis. The compound crystallized in long thin plate-like crystals from the methanol-ether mixture but crystallized in needles from chloroform by the addition of petroleum ether as described by Kögl and Tönnis. A full presentation of the chemical and physical properties of the compound will appear elsewhere. The biological activity and melting point of the pure biotin methyl ester were confirmed by several separate isolations. Furthermore, sublimation *in vacuo* followed by crystallization from a mixture of methanol and ether did not change the melting point, crystalline form or biological activity.

Using the yeast growth method,[6] we have compared the biotin activity of our purified crystalline material with the biotin activity of the vitamin H preparation (34 vitamin H units per mg) that we had used as an arbitrary standard in our previous communication.[3] *Expressed in terms of vitamin H units,* the various preparations of purified product that we have made have all consistently yielded, in the yeast growth method, the high value of 27,000 (± 10 per cent.) vitamin H units per mg. Direct vitamin H assays of our crystals, made on rats by the curative method, are in agreement with this high potency.

It may be added that Professor Dean Burk, using *Rhizobium trifolii* Strain 209, has found that our crystals possess "coenzyme R activity" of maximum observed potency, half-maximum growth being obtained at about 0.00001 γ per cc of growth medium and 95–100 per cent. maximum growth at 0.0001 γ per cc. This confirms, with strictly pure biotin ester, the conclusion of Nilsson, Bjälfve and Burström,[7] and of West and Wilson[8] that coenzyme R and biotin are identical. Our crystalline biotin ester was also found to be effective in promoting the growth of *Clostridium butylicum* Strain 21, by Dr. D. W. Woolley, of the Rockefeller Institute for Medical Research. Dr. Woolley's quantitative comparison of this crystalline material with Kögl's sample, made by assay with this organism, confirmed the ratio of potencies given above.

In conclusion we may state that the crystalline biotin ester prepared by us, purified to constant melting point and constant biotin activity, possesses such an extremely potent vitamin H activity—far beyond any previously known degree of activity—as to leave no doubt that vitamin H and biotin are one and the same compound. The behavior of the material in our hands has convinced us that we are dealing with an individual compound possessing the several biological activities mentioned in this note.

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Catharine S. Rose
The Babies and Childrens Hospital, and
Department of Pediatrics, School of Medicine,
Western Reserve University, Cleveland
Klaus Hofmann[9]
Donald B. Melville[10]
Vincent du Vigneaud
Department of Biochemistry,
Cornell University Medical College, N. Y.

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[1] In this cooperative research reported here, the Cornell group has been responsible for the chemical work and for the biotin assays, and the Western Reserve group for the vitamin H assays.

[2] The authors would like to express their appreciation to W. O. Frohring, president of the S.M.A. Corporation, for his interest and genuine cooperation and to the research staff of the S.M.A. Corporation and Miss Eleanor Hague for technical assistance in the biotin assays.

[3] V. du Vigneaud, D. B. Melville, P. György, C. Rose, Science, 92: 62, 1940.

[4] P. György, D. B. Melville, D. Burk, V. du Vigneaud, Science, 91: 243, 1940.

[5] F. Kögl and B. Tönnis, *Z. Physiol. Chem.*, 242: 43, 1936.

[6] E. E. Snell, R. E. Eakin and R. J. Williams, *Jour. Am. Chem. Soc.*, 62: 175, 1940.

[7] R. Nilsson, G. Bjälfve and D. Burström, *Naturwissenschaften*, 27: 389, 1939.

[8] P. M. West and P. W. Wilson, Science, 89: 607, 1939.

[9] Dr. Hofmann's participation in this work has been made possible by a fellowship granted to him by the Society for Chemical Industry, Basle, Switzerland.

[10] S.M.A. Corporation fellow.

AN IRRADIATED NON-VIRULENT ANTIRABIES VACCINE

WE are attempting to improve antirabies vaccines for animal prophylaxis and for treatment of man.

The mouse potency test developed in our laboratory has proved reliable[1,2,3] and has shown that commercial phenolized vaccines of 1937 to 1939 for the most part failed to immunize mice, whereas chloroformized vaccines immunized, provided two to five times the stated dose was employed.[1]

New vaccines are now being developed and tested in mice and dogs with the following results. First, we found that to immunize mice about 1,000 mouse intracerebral lethal doses of virulent tissue culture virus were required and 50,000 doses of irradiated non-virulent virus.[4] Second, we learned that to immunize dogs weighing about 500 times as much as mice, 500 times this dose of irradiated virus was required. Since tissue culture virus contains a relatively small number of mouse doses per cubic centimeter, 33,000, large volumes were required to contain the proper number of doses for dogs—300 to 500 cc. As this volume was impractical for vaccination, attempts were made to increase the titre of virus in the tissue culture, but without success. On the other hand, a tenfold concentration of culture virus without loss of immunizing potency was achieved readily by freezing and drying procedures, so that 0.1 cc of concentrated irradiated vaccine immunized mice to the same extent as 1.0 cc of unconcentrated vaccine.

Infected brain tissue, however, remained the most potent source of virus. Brains from infected prostrate Swiss mice or 1-month-old dogs titred 33,000,000 or more mouse lethal doses per cc—this is 1,000 times the titre of tissue culture virus; guinea pigs generally titred 3,000,000, and rabbits 330,000 mouse doses per cc. From these infected mouse or dog brains an irradiated non-virulent vaccine was prepared as follows:

A 1 per cent. emulsion of virus-containing brain tissue was homogenized and then centrifuged at 500 r.p.m. for 5 minutes and the supernatant removed. This supernatant, in order to immunize, must titre 330,000 mouse doses per cc and be free of relatively large particles. It was rendered non-virulent by 20 minutes' exposure to ultraviolet light.

This material was then tested for its immunizing potency, as illustrated in the following protocol. Thirty mice were each given intraperitoneally a single injection of 0.5 cc (1,600,000 doses), thirty mice, 0.1 cc (330,000 doses), and thirty mice, 0.1 cc of vaccine diluted ten times (33,000 doses). Three weeks later these vaccinated mice plus similar non-vaccinated controls were tested for immunity against graded doses of virulent virus injected into the gastrocnemius muscle. Table I shows that 0.5 cc and 0.1 cc of vaccine protected the mice against at least sixty-four times the minimum fatal dose for non-vaccinated mice, and that 0.1 cc of vaccine diluted ten times protected them against four doses. Numerous experiments with mouse and dog brain vaccines and with various strains of street virus as the testing agent have given similar results.

TABLE I

IMMUNIZING POTENCY OF IRRADIATED 1 PER CENT. SUPERNATANT MOUSE BRAIN VIRUS FOR MICE

Virulence of brain-virus before irradiation, 0.03 cc × 10^{-7}

Virulence of 1 per cent. brain-virus supernatant following 35 minutes' irradiation = 0

Immunity of Mice Vaccinated with Graded Doses of 1 Per Cent. Irradiated Vaccine

Amount of vaccine	No. of mouse intracerebral lethal doses in vaccine	Mortality of mice following intramuscular injection of 0.01 cc of virulent virus in dilutions:									Amount of immunity in minimum lethal doses
		1 : 10	1 : 20	1 : 40	1 : 80	1 : 160	1 : 320	1 : 640	1 : 1280	1 : 2560	
0.5 cc	1,600,000	1/5*	2/5	0/5	0/5	0/5	1/5	–	–	–	64
0.1 "	330,000	2/5	0/5	1/5	0/5	1/5	0/5	–	–	–	64
0.1 " (of 0.1 per cent. vaccine)	33,000	1/4	0/5	1/5	2/5	2/5	1/5	–	–	–	4
None	0	–	–	4/5	4/5	3/5	3/5	4/5	5/6	1/4	–

* 1/5 = 1 of 5 mice died of rabies following the test injection.
– = Dilution not tested.

The irradiated vaccine was tested in dogs with results illustrated by the following protocol. Eight young beagle dogs weighing about 300 times as much as the test mice were given intraperitoneally 30 cc of the non-virulent irradiated vaccine; eight were given 10 cc three times at weekly intervals, an amount at least 300 times the dose necessary for mice; eight* dogs received 6 cc of commercial chloroformized 20 per cent. vaccine intraperitoneally, and eight dogs were left unvaccinated as controls. Four weeks following the first injection all dogs were given 0.25 cc of 5 per cent. street rabies virus into the neck muscles of each side. Table II shows mortalities from rabies: eight of eight controls, 100 per cent.; four of six

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[1] L. T. Webster, *Jour. Exp. Med.*, 70: 87, 1939.

[2] R. W. G. Wyckoff and C. E. Beck, *Jour. Immunol.*, 39: 17, 1940.

[3] K. Habel, *U. S. Pub. Health Rep.*, 55: 1473, 1940.

[4] H. L. Hodes, L. T. Webster and G. I. Lavin, *Jour. Exp. Med.*, 72: 437, 1940.

* Two of these dogs died of distemper early in the course of the experiment.

TABLE II

IMMUNIZING EFFECT IN DOGS OF IRRADIATED BRAIN ANTIRABIES VACCINE

Vaccination of dogs	Day of death from rabies	Per cent. mortality from rabies
Irradiated vaccine, 30 cc, 1 dose	....	0
Irradiated vaccine, 10 cc, 3 doses	....	0
Chloroformized vaccine, 6 cc. 1 dose	20, 23, 40, 43	67
No vaccine—controls	17, 20, 25, 27, 30, 30, 37, 41	100

dogs given chloroformized vaccine, 67 per cent.; none of the sixteen dogs given irradiated vaccine, 0 per cent.

Total mortalities to date among vaccinated and non-vaccinated dogs following test inoculation of rabies virus are shown in Text-Fig. 1 as follows: 115 of 136 non-vaccinated dogs, 84 per cent.; 45 of 62 receiving 5 cc of commercial phenolized canine vaccine subcutaneously, 72.6 per cent.; 22 of 44 receiving 5 cc of commercial chloroformized canine vaccine, 50 per cent.; 25 of 32 receiving less than 20 cc of the 1 per cent. irradiated vaccine, 78 per cent.; 2 of 10 receiving 20 cc, 20 per cent.; whereas only one of 35 dogs given 30 cc, and in one test 40 cc, succumbed to the test injection, 3 per cent.

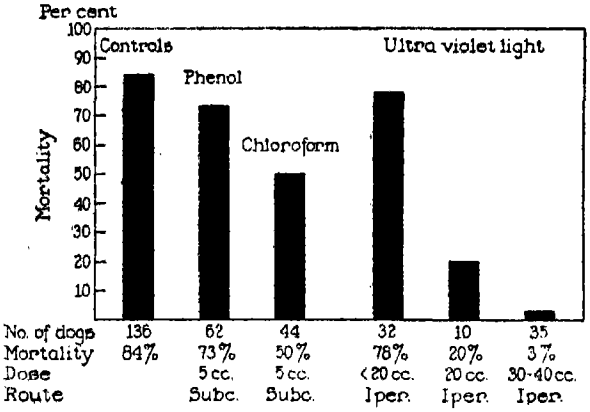

FIG. 1.

This irradiated vaccine retains its immunizing capacity after 9 months' storage at 40° F.

Experiments on further concentration of vaccine and optimum route of inoculation are in progress.

LESLIE T. WEBSTER
J. CASALS

THE LABORATORIES OF THE
ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN INEXPENSIVE APPARATUS FOR DRYING FROM THE FROZEN STATE

SPECIALLY prepared calcium sulfate, "Drierite," has been suggested[1] as an economical desiccant for drying biological materials *in vacuo* from the frozen state. A simple, inexpensive apparatus has been devised for application of this principle to the preservation of virus and serum proteins.

The apparatus, shown in Fig. 1, is constructed about the large size (25 quart) National Canner Retort,[2] (A), which serves as the desiccant chamber. This retort can be purchased at low cost and most of the associated parts can be assembled in the laboratory. The retort comes equipped with a rubber gasket and an inside wire rack. In the cover are 4 fittings with ⅛ inch standard pipe threads. The fittings are removed and 2 holes closed with standard plugs. A third opening is used as a vacuum release through the attached calcium chloride bottle (B). The fourth opening is rebored and threaded for a ⅜ inch pipe elbow for the vacuum lead (C) (½ inch pressure tubing). In the center of the cover an additional hole is drilled and tapped with a ½ inch pipe thread; into it is screwed an 8 inch length of ¾ inch O.D. brass tubing (D) for connection with the manifold (E). Into the lower end of (D) is sweated another brass tube (F) which extends within the retort to ½ to 1 inch of the bottom.

The manifold (E) is 1¼ inch O.D. brass tubing 16 inches long. The 16 outlets (G) are 5/16 inch O.D.

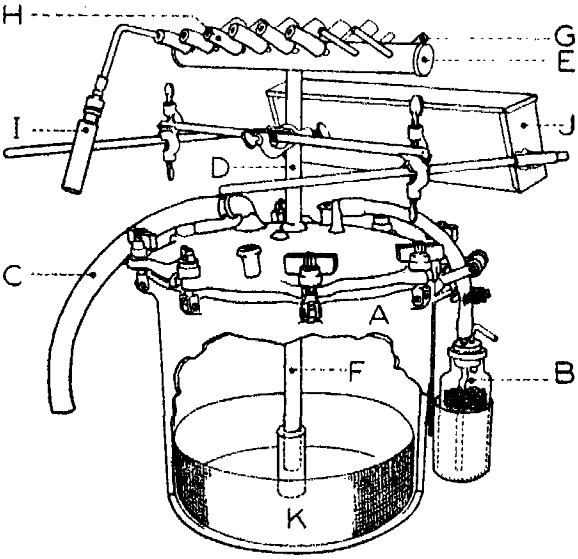

FIG. 1

brass tubing 1¼ inches long placed 1⅞ inches apart at an angle of 60° from vertical. All brass to brass joints and manifold caps are soldered or brazed and the threaded joints in the cover are sealed with "Apiezon."[3] Short lengths of ¼ inch pressure tubing (H) are used to connect the freezing and drying containers (I) to the manifold outlets. Construction and mounting of supports and of 2 sheet copper trays (J) for holding freezing mixture are evident. Castor oil may be used on the bevelled rubber gasket for sealing the retort.

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[1] E. W. Flosdorf and S. Mudd, *Jour. Immunol.*, 34: 469, 1938.

[2] National Pressure Cooker Company, Eau Claire, Wisconsin.

The "Drierite" is held in 3 circular baskets (K) of hardware cloth, 3½ inches high by 11 inches in diameter, constructed with a tubular central opening through which passes the pipe extension (F). The 3 baskets are stacked in the wire rack supplied with the retort and may be removed separately or as a unit for regeneration of the desiccant. Details of the regeneration procedure are given by Flosdorf and Mudd[4] and for this a cheap gas oven is applicable.

The desiccant chamber holds 25 pounds of "Drierite," the total capacity of which is 400 cc without regeneration. The single run capacity is 125 to 150 cc and a Cenco Hyvac pump has proven adequate. Either preliminary freezing with a Dry-Ice-alcohol mixture or the degassing-self-freezing procedure[5] may be used, though the former method is recommended. Standard freezing and drying containers and connections obtainable on the market are used.

The apparatus shown may be constructed for approximately $35.00 or less and has been flexible and reliable in practice. It occupies only 4 square feet of table space.

A. R. Taylor
J. W. Beard

Duke University School of Medicine

CONVENIENT HEAT FILTER FOR TISSUE ILLUMINATOR[1]

In the quartz rod tissue illuminator described by Knisely[2] and in use at our laboratories, a large amount of heat accompanies the passage of light through the tissues. This occurs because some 85 per cent. of the energy consumed by the usual electric light bulb used as the light source is emitted as heat. The heating of the tissues being examined is usually minimized by flowing a continuous stream of properly warmed Ringer's solution over the area under observation. This treatment is not very convenient experimentally, and, as Knisely points out,[3] somewhat disrupts normal physiological processes. It was found in our laboratory that the insertion of a double thickness of inexpensive "heat-filter" glass (Cenco 87305) at the break in the quartz rod light conductor cuts down the heat transmitted to the tissue to at least one seventh of its previous value, yet reduces the intensity of light transmitted by only a small fraction. In general, this means that the heat transmitted is so small as to be safely absorbed by the tissue and thus the use of Ringer's solution as a cooling agent may be avoided.

Herbert A. Pohl

Carnegie Institution of Washington,
Baltimore, Md.

AN ELECTRONIC RELAY FOR HEAT CONTROL

Several letters have been sent us stating that the relay in the circuit we described[1] chatters when operated on 115 volts a-c. Our relay, equipped with a 50 × – 115-volt 60 cps coil, does not chatter but we also have found that many of the same type do. This chattering can be avoided by connecting a 450-volt 4 microfarad condenser (the electrolytic tubular type can be used) between the point marked C in Fig. 1 of the previous article and the No. 3 prong of the socket for the 25L6G tube. The positive terminal of the condenser should be connected to C. Using this condenser and shorting the 1000 ohm resistor nearest C, we have also been able to use the Potter and Brumfield relay, type PRA-1 with a 110-volt 60 cps coil, whose contacts are rated to carry 20 amperes a-c. There are, of course, many other makes of relays that can be used.

Albert C. Hall
Lawrence J. Heidt

Massachusetts Institute of Technology

[1] Science, 92: 133.

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[3] Sealing Compound "Q," James G. Biddle Company, 1211–13 Arch St., Philadelphia, Pa.

[4] E. W. Flosdorf and S. Mudd, *op. cit.*

[5] *Ibid.*

[1] Aided by a grant from the Rockefeller Foundation Fluid Research Fund of the School of Medicine, Johns Hopkins University.

[2] M. H. Knisely, *Anat. Rec.*, 58 (Suppl.): 53; *Proc. Soc. Exp. Biol. and Med.*, 32: 212; *Anat. Rec.*, 64 (Suppl.): 499.

[3] M. H. Knisely, *Anat. Rec.*, 64 (Suppl.): 499, 1935.

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